GENERAL, TECHNICAL DATA

TECHNICAL DATA

Engine number

The engine number ("Code letters" and "Serial number") can be found on the front at the connection between the engine and transmission.

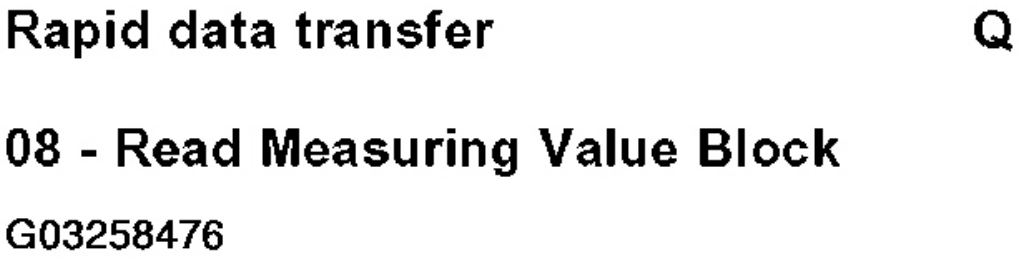

Fig. 1: Identifying Engine Number Location
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Additionally there is a sticker on the cylinder head cover with "Engine code" and "Serial number."

The engine code is also included on the vehicle data plate.

Engine data

ENGINE DATA

Engine code	APH	AWV	AWP
Manufactured starting	02.99 and up	07.00 and up	09.01 and up
Exhaust gas limits according to	OBD II	OBD II	OBD II
Displacement l	1.8	1.8	1.8
Output kW @ RPM	110/5800	110/5700	132/5500
Torque N.m @ RPM	220 @ 2000 to 4200	220 @ 1750 to 4600	235 @ 1950 to 5000
Bore diameter mm	81.0	81.0	81.0
Stroke mm	86.4	86.4	86.4

Compression ratio	9.5:1	9.5:1	9.5:1
RON min.	95 unleaded	95 unleaded	98 unleaded
System identification	Motronic ME7.5	Motronic ME7.5	Motronic ME7.5
Emissions limits according to	TLEV(1)	LEV(2)	LEV(2)
Knock sensor control	2 knock sensors	2 knock sensors	2 knock sensors
On Board Diagnostic (OBD)	OBD II	OBD II	OBD II
Oxygen sensor control	2 sensors	2 sensors	2 sensors
Three Way Catalytic Converter (TWC)	yes	yes	yes
Exhaust Gas Recirculation (EGR)	no	no	no
Variable intake manifold	no	no	no
Camshaft adjustment	no	yes	yes
Turbocharging system	yes	yes	yes
Boost pressure regulation	yes	yes	yes
Secondary air system	yes	yes	yes

(1) TLEV = Transitional Low Emission Vehicles (emission values max. 0.125 g/mi HC)

(2) LEV = Low Emission Vehicles (emission values max. 0.075 g/mi HC)

ENGINE - ASSEMBLY

ENGINE, REMOVING AND INSTALLING

Special tools and equipment

- VW 313 Support clamp
- VW 540 Engine and transmission support
- 2024 A Lifting tackle
- 3180 Retainer (for turbocharged engines)
- VAG1202 A Workshop crane
- VAG1306 Drip tray

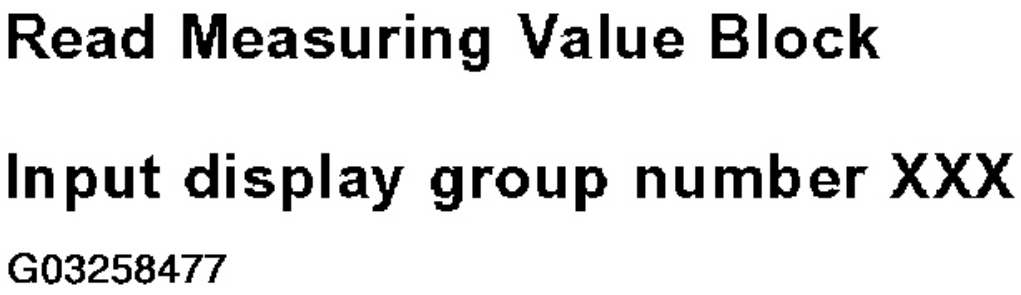

Fig. 2: Identifying Special Tools And Equipment (1 Of 2)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- VAG1331 Torque wrench (5-50 N.m)
- VAG1332 Torque wrench (40-200 N.m)
- VAG1383 A Engine/transmission jack
- T10012 Engine bracket
- VAS 5024 Assembly tool for spring-type clamps
- V.A.S 5085 Step ladder (not shown)
- G 000 100 grease (vehicles with manual transmission) (not shown)
- Bolt M1 0X 25 / 8.8 (not shown)
- Cable tie (not shown)

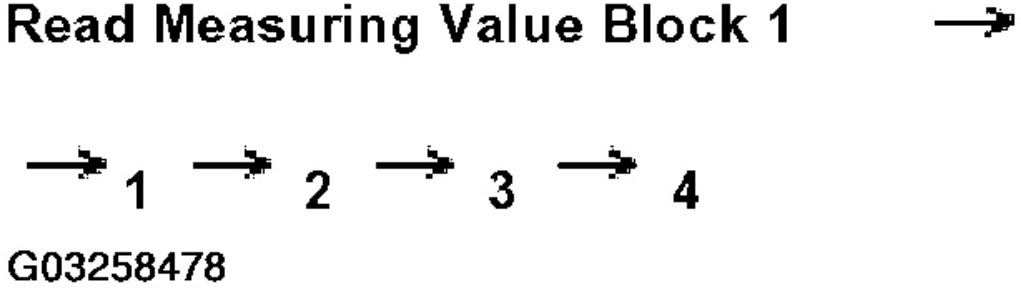

Fig. 3: Identifying Special Tools And Equipment (2 Of 2)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Removal notes

- First check whether a coded radio is installed. If so, obtain anti-theft coding.

The engine is removed downward together with the transmission.

- With ignition switched off, disconnect battery Ground strap.
- All cable ties which are opened or cut open when removing engine must be replaced in same position when installing engine.
- Remove engine cover.
- Remove air cleaner:

  See **AIR FILTER, DISASSEMBLING AND ASSEMBLING** .

- Remove intake hose between Mass Air Flow (MAF) sensor -G70- and turbocharger.

  See **FUEL INJECTION, SERVICING** .

- Remove power steering fluid reservoir from battery holder without disconnecting hoses.
- Fasten reservoir to lock carrier.
- Remove battery and battery retainer.
- Pull vacuum and breather hoses off engine.

WARNING:

- **Fire Hazard! Do NOT have anything in the area that can ignite fuel!**
- **Fuel supply lines are under pressure! Before removing from hose connection wrap a cloth around the connection. Then release pressure by carefully pulling hose off connection.**

- Pull off supply line/hose -1- (with white marking) and return line/hose -2- (with blue marking) and collect fuel that leaks out with a cloth.

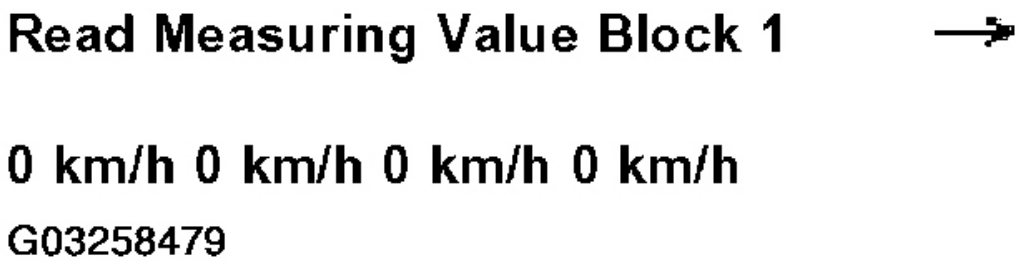

Fig. 4: Pulling Off Supply Line/Hose And Return Line/Hose
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Seal pipes so that fuel system is not contaminated by dirt etc.
- Pull hose off solenoid valve.

NOTE: Press buttons on hose couplings to do this.

- Loosen and remove intake hose (between charge air cooler and Throttle Valve Control Module -J338-) at Throttle Valve Control Module -J338-.
- Disconnect harness connector for Intake Air Temperature (IAT) sensor -G42-, -1- and -4- for Throttle Valve Control Module -J338- below Throttle Valve Control Module -J338-.

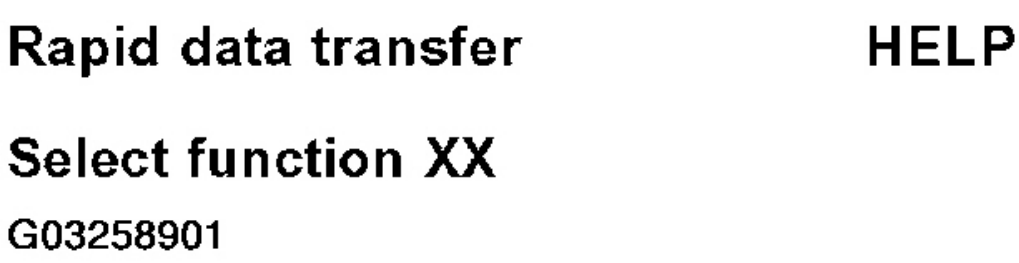

Fig. 5: Disconnecting Harness Connector For Intake Air Temperature Sensor G42
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Pull connector off Camshaft Position (CMP) sensor -G40- -arrow-.

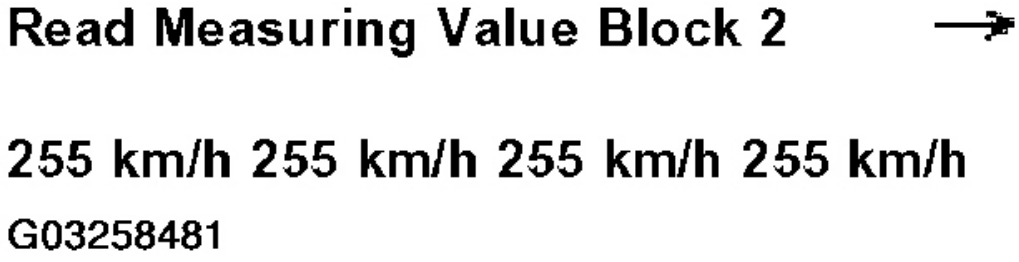

Fig. 6: Pulling Connector Off Camshaft Position Sensor G40
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Unbolt vacuum canister from cylinder head cover and pull from bracket.
- Disconnect fuel injectors harness connector and unclip bracket rail from fuel distributor.
- Unscrew Ground wire between ignition coil -1- and -2-.
- Disconnect connectors from ignition coils.
- Disconnect connector for speedometer Vehicle Speed Sensor -G22- at rear of transmission.
- Remove center, left and right insulation tray:

  See **PLENUM CHAMBER INNER COVER, REMOVING AND INSTALLING** .

- Remove air duct to charge air cooler at lower right of long member.

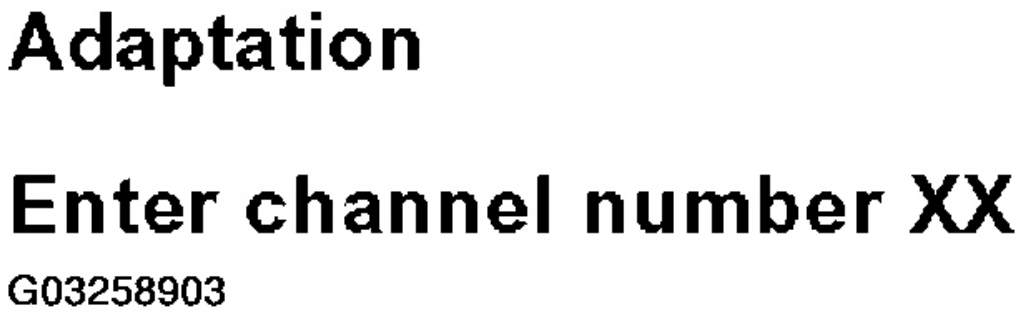

Fig. 7: Removing Air Duct To Charge Air Cooler At Lower Right Of Long Member
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Vehicles with manual transmission 02J

- Disconnect selector mechanism from transmission.

  See **SELECTOR MECHANISM ON TRANSMISSION SIDE, UP TO 05.99, DISASSEMBLING AND ASSEMBLING** or **SELECTOR MECHANISM ON TRANSMISSION SIDE, AS OF 06.99, DISASSEMBLING AND ASSEMBLING** .

- Remove hydraulic clutch slave cylinder.

  See **CLUTCH SLAVE CYLINDER** .

Vehicles with manual transmission 02M

- Disconnect selector mechanism from transmission.

  See **SELECTOR LEVER LOCK SOLENOID** .

- Remove hydraulic clutch slave cylinder.

  See **CLUTCH RELEASE BEARING/SLAVE CYLINDER** .

  NOTE: Clutch pedal must not be depressed.

Vehicles with automatic transmission

- Remove selector lever cable from transmission:

  See **SELECTOR LEVER CABLE** .

Continued for all vehicles

- Drain coolant. See **COOLING SYSTEM, DRAINING AND FILLING** .

  WARNING: Observe proper disposal regulations!

- Pull radiator coolant hoses off engine.

  NOTE: The VAS 5024 assembly tool or VAG 1921 pliers are recommended for removing and installing the spring-type clamps.

- Remove coolant hoses at heater core.
- Remove coolant hose to coolant pipe at Throttle Valve Control Module -J338-.

- Remove additional fan at right side of vehicle if present.
- Disconnect both harness connectors for cooling fan at notch at left bottom.
- Remove inter-connecting, coolant, vacuum and intake hoses on engine.
- Remove connecting hoses -arrows- between secondary air pump/combi-valve and secondary air pump/air cleaner.

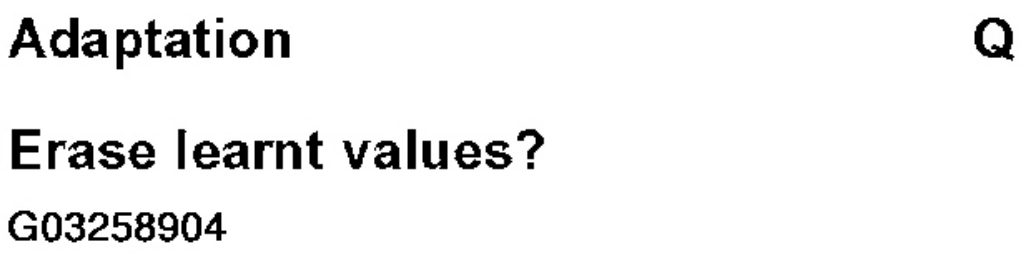

Fig. 8: Removing Connecting Hoses Between Secondary Air Pump/Combi-Valve And Secondary Air Pump/Air Cleaner
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: Press buttons on hose couplings to do this.

- Pull connector -1- off secondary air pump.
- Remove secondary air pump motor and bracket.
- Disconnect all electric wires from transmission, alternator and starter and move clear.
- Remove securing clamps for power steering pressure pipe.
- Remove ribbed belt. See **RIBBED BELT TENSIONER, REMOVING AND INSTALLING** .
- Remove power assisted steering vane pump with bracket and lay to side; hoses remain connected.

See **POWER STEERING PUMP, RESERVOIR, HYDRAULIC LINES** .

WARNING: The air conditioner refrigerant circuit must not be opened.

Vehicles with air conditioner

- Remove air conditioner compressor.
- Observe additional notes and assembly work. See **INSTALLATION NOTES** .
- Remove generator.

See **GENERATOR** .

- Remove compact bracket including tightening element for ribbed V-belt. See COMPACT BRACKET , item 22.

Continued for all vehicles

- Remove protective cover for right-hand inner constant velocity joint from engine.
- Remove right-hand drive shaft and disconnect left-hand drive shaft at transmission.

  See **FRONT AXLE SHAFT**

- Remove pendulum support -arrows-.

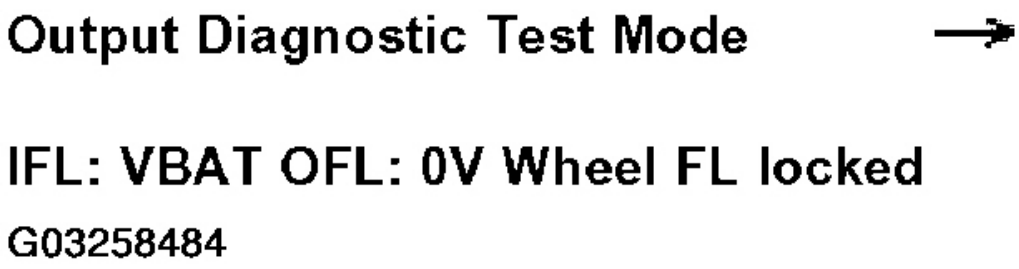

Fig. 9: Removing Pendulum Support
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove front exhaust pipe with catalytic converter. See **EXHAUST MANIFOLD, FRONT EXHAUST PIPE AND CATALYST WITH ATTACHMENTS** .
- Install engine bracket T 10012 onto cylinder block with a securing nut and M10 X 25/ 8.8 bolt and tighten to approx. 40 N.m.

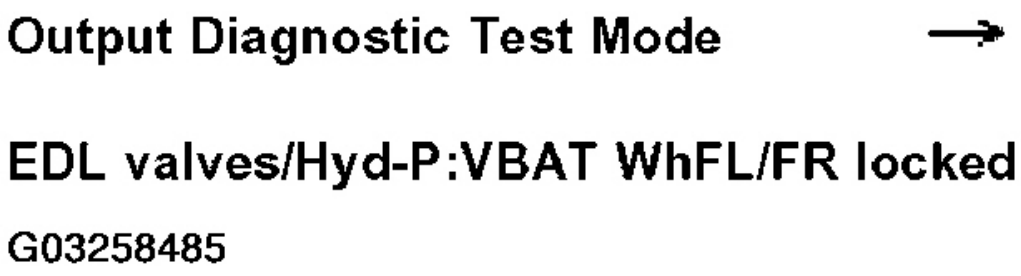

Fig. 10: Installing Engine Bracket T 10012 Onto Cylinder Block
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Lift engine and transmission lightly using engine/transmission jack VAG 1383 A.
- Unbolt engine side of assembly mount from engine carrier at top -arrows-.

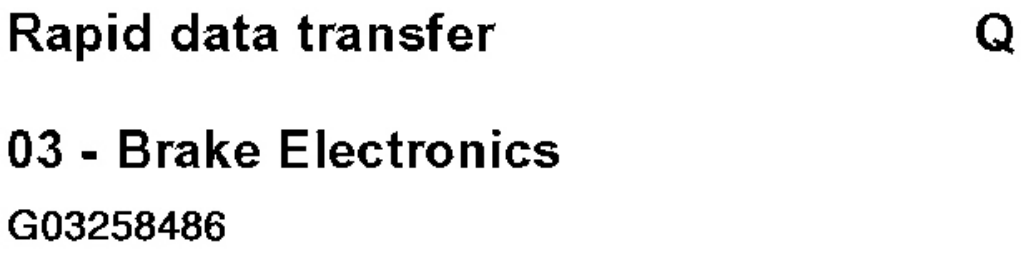

Fig. 11: Unbolting Engine Side Of Assembly Mount From Engine Carrier At Top
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: To remove securing bolts use step ladder VAS 5085.

- Unbolt transmission side of assembly mount from transmission carrier at top -arrows-.

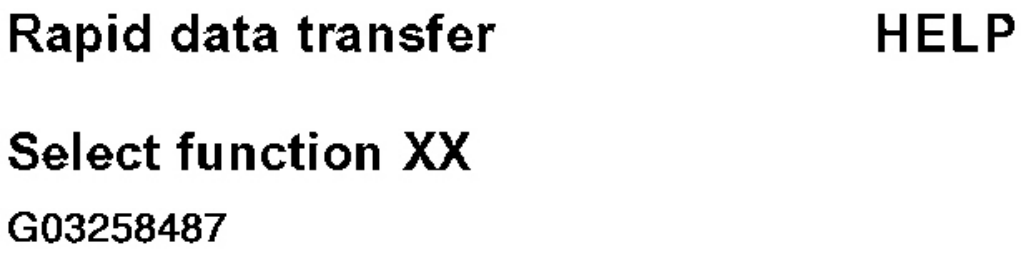

Fig. 12: Unbolting Transmission Side Of Assembly Mount From Transmission Carrier At Top
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Carefully lower engine with transmission and guide power steering pressure line past transmission.

NOTE: Engine with transmission must be guided carefully when lowering to prevent damage to the bodywork.

Engine, securing to assembly stand

When working on the engine, it should be secured to the assembly stand support clamp VW 313 using the engine and transmission bracket VW 540.

Work sequence

- Move engine/transmission with VAG1383 A lift to a workbench.

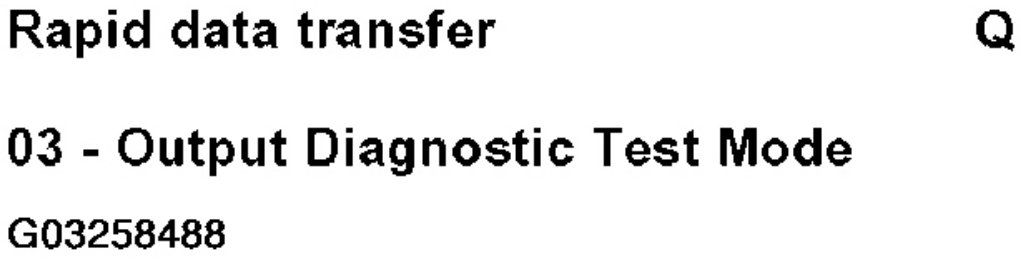

Fig. 13: Moving Engine/Transmission With VAG1383 A And Lifting To Workbench
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Lower engine/transmission unit so that transmission is supported (at supporting point).
- Remove transmission.

Vehicles with automatic transmission

- Secure torque converter against "falling out" after separating engine from transmission.

Continued for all vehicles

- Attach lifting tackle 2024 A with bracket 3180 as follows and lift off engine/transmission jack VAG 1383 A with workshop crane VAG 1202 A.

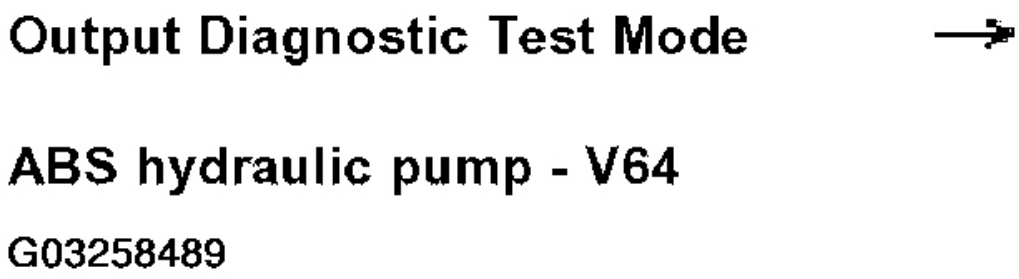

Fig. 14: Attaching Lifting Tackle 2024 A With Bracket 3180 And Lifting Off Engine/Transmission Jack VAG 1383 A
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Pulley end: 3rd hole in hook at position 1

Flywheel end: 2nd hole in hook at position 5

WARNING: The hooks and locating pins must be secured with locking pins.

NOTE:

- **The positions marked 1-4 on the bar must be toward the pulley end.**
- **The holes in the hooks are counted up from the hook.**

- Secure engine to support clamp VW 313 using engine and transmission bracket VW 540.

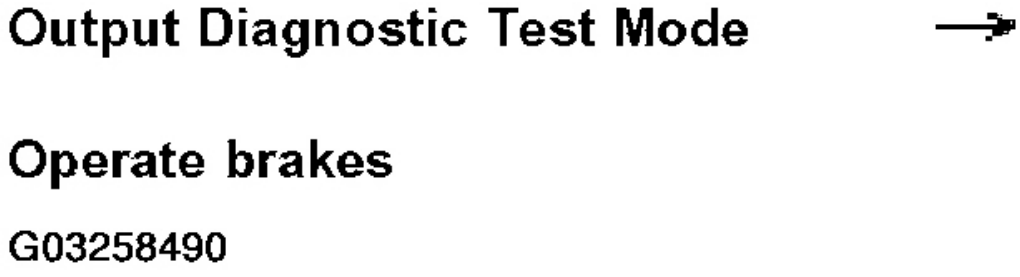

Fig. 15: Securing Engine To Support Clamp VW 313 Using Engine And Transmission Bracket VW 540
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Installation notes

Installation is carried out in the reverse sequence. Also note the following:

CAUTION: When doing any repair work, especially in the engine compartment, due to the cramped conditions, pay attention to the following:

- **Route all sorts of lines (e.g. for fuel, hydraulics, EVAP system, coolant, refrigerant, brake fluid and vacuum lines and hoses, etc.) and electrical wiring so that the original positions are restored.**
- **Ensure sufficient clearance to all moving or hot components.**

- Check whether dowel sleeves for centering engine/transmission are in cylinder block, install if necessary.
- Install intermediate plate onto sealing flange and slide onto dowel sleeves -arrows-.

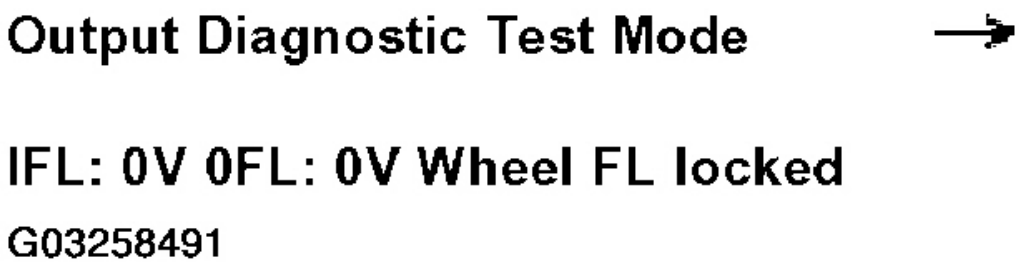

Fig. 16: Installing Intermediate Plate Onto Sealing Flange And Sliding Onto Dowel Sleeves
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Vehicles with manual transmission

- Check centering of clutch drive plate, if necessary.
- Check clutch release bearing for wear, replace if necessary.
- Lightly grease clutch release bearing, release bearing guide sleeve and splines on input shaft with G 000 100.

Vehicles with manual transmission 02J

- Install hydraulic clutch slave cylinder:

  See **CLUTCH SLAVE CYLINDER**

- Install selector mechanism.

  See **SELECTOR MECHANISM ON TRANSMISSION SIDE, UP TO 05.99, DISASSEMBLING AND ASSEMBLING** or **SELECTOR MECHANISM ON TRANSMISSION SIDE, AS OF 06.99, DISASSEMBLING AND ASSEMBLING**

- If necessary, adjust shifter cables:

  See **SELECTOR MECHANISM**

Vehicles with manual transmission 02M

- Install hydraulic clutch slave cylinder:

  See **CLUTCH RELEASE BEARING/SLAVE CYLINDER**

- Install selector mechanism.

  See **SELECTOR LEVER LOCK SOLENOID**

- If necessary, adjust shifter cables:

  See **SELECTOR MECHANISM**

Vehicles with automatic transmission

- Only use nuts approved in parts program to secure torque converter to drive plate.
- Install selector cable on transmission, adjust if necessary:

  See **SELECTOR LEVER CABLE**

- Adapt control module for automatic transmission:

  See **BASIC SETTING, INITIATING**

Continued for all vehicles

- When installing assembly, ensure sufficient clearance to drive shafts.

Vehicles with air conditioner

- Install generator.

  See **GENERATOR**

- Install compact bracket including tightening element for ribbed V-belt. See COMPACT BRACKET , item 22.

  PART I

- Install A/C compressor.

Continued for all vehicles

- Align engine and transmission mounts. See **ENGINE AND TRANSMISSION MOUNTS, ALIGNING** .
- Install drive shafts:

  See **FRONT AXLE SHAFT**

- Install right hand inner constant velocity joint protective cover from engine.

- Install front exhaust pipe. See **EXHAUST SYSTEM COMPONENTS, REMOVING AND INSTALLING** .
- Install intake hose (between charge air cooler and Throttle Valve Control Module) onto Throttle Valve Control Module -J338- and secure.
- Install power steering pump:

  See **POWER STEERING PUMP IN LOWER SECTION, ASSEMBLY OVERVIEW** or **POWER STEERING PUMP IN UPPER SECTION, ASSEMBLY OVERVIEW**

- Check electrical connections and routing:

  See appropriate WIRING DIAGRAM article.

- Install ribbed belt. See **RIBBED BELT TENSIONER, REMOVING AND INSTALLING** .
- Install center, left and right insulation trays:

  See **PLENUM CHAMBER INNER COVER, REMOVING AND INSTALLING**

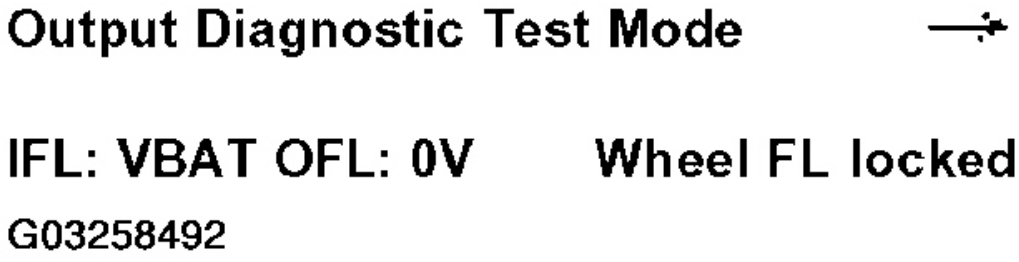

Fig. 17: Installing Center, Left And Right Insulation Trays
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Install secondary air pump.
- Install connecting hoses between secondary air pump to combination valve and secondary air pump to air cleaner.
- Fill with coolant. See **COOLING SYSTEM, DRAINING AND FILLING** .
- Perform work sequence "Procedure after correcting voltage supply open circuit".

  See **PROCEDURE AFTER CORRECTING VOLTAGE SUPPLY OPEN CIRCUIT** .

- Test drive vehicle.

Observe the valid safety precautions when carrying out a road test.

See **SAFETY PRECAUTIONS** .

- Check DTC memory and read readiness code:

  See **GENERAL INFORMATION FOR ON BOARD DIAGNOSTIC** .

- Generate readiness code again if DTC memory has been erased or engine control module separated from permanent positive.

  See **READINESS CODE**

Tightening torques

TIGHTENING TORQUES

Bolted joint		**Tightening torque**
Bolts, nuts	M6	10 N.m
	M7	15 N.m
	M8	25 N.m
	M10	40 N.m
	M12	60 N.m
Exceptions:		
Engine to transmission connecting bolts	M10	45 N.m
Engine to transmission connecting bolts	M12	80 N.m
Torque converter to drive plate		60 N.m
Drive shaft to joint flange/transmission		40 N.m

NOTE: Assembly mounting tightening torques. See ENGINE/TRANSMISSION MOUNTS .

Engine and transmission mounts, aligning

Engine mount

WARNING: Before loosening the bolts the assemblies must be secured with the special tool 10-222A.

a = 14.0 mm

b = at least 10.0 mm

Both bolt heads 1 must be in flush with edge -c-.

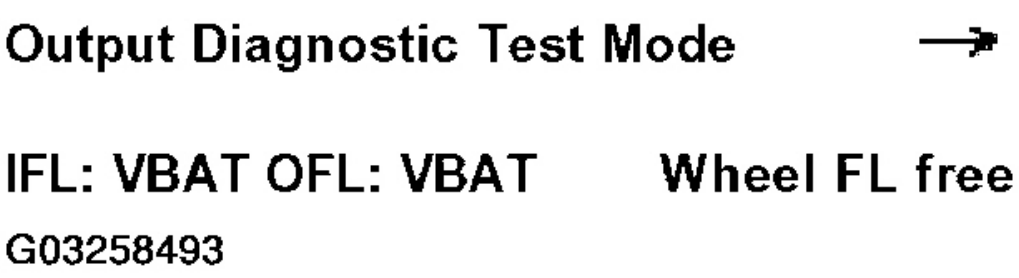

Fig. 18: Aligning Engine Mount
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Transmission mount

Edges -a- and -b- must be parallel with one another.

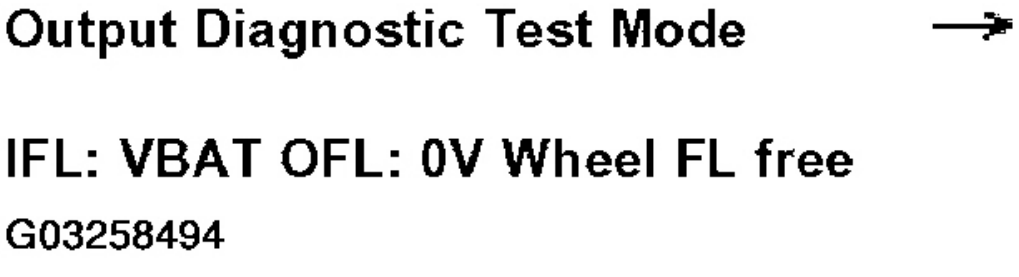

Fig. 19: Aligning Transmission Mount
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Engine/transmission mounts

Tightening torques

Engine mount

1. Mount to body: 40 N.m + 90° (1/4 turn)

NOTE: Replace bolts

2. Mount/bracket to body: 25 N.m
3. Mount to engine bracket 100 N.m

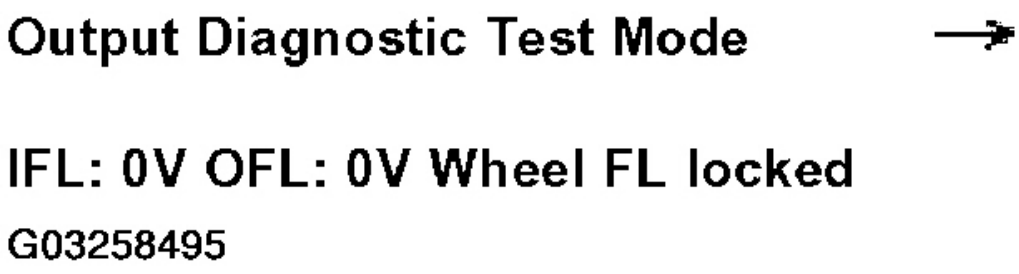

Fig. 20: Engine Mount Tightening Torques
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Transmission assembly mount

1. Mount to body: 40 N.m + 90° (1/4 turn)

NOTE: Replace bolts

2. Mount to body: 25 N.m
3. Mount to transmission console 100 N.m

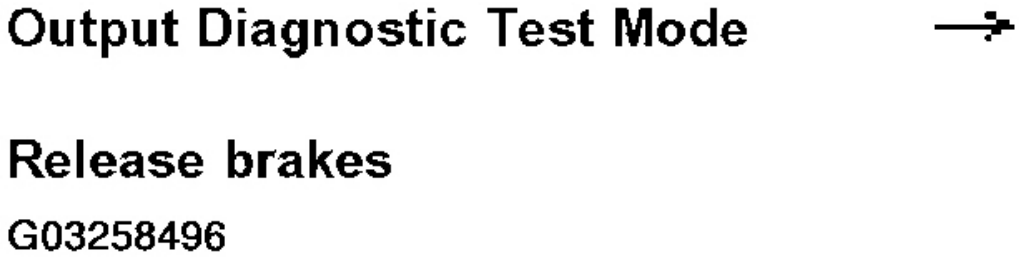

Fig. 21: Transmission Assembly Mount Tightening Torques
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Pendulum support

1. Pendulum support to transmission: 40 N.m + 90° (1/4 turn)

   NOTE: Replace bolts

2. Pendulum support to transmission: 40 N.m + 90° (1/4 turn)

   NOTE: Replace bolts

3. Pendulum support to subframe: 20 N.m + 90° (1/4 turn)

   NOTE: Replace bolts

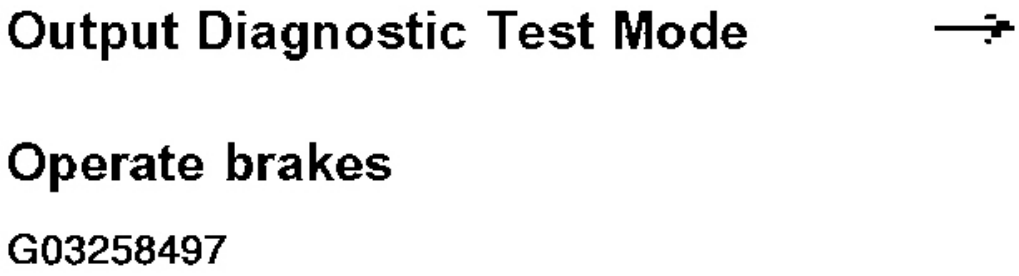

Fig. 22: Pendulum Support Tightening Torques
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Additional information and removal instructions for vehicles with air conditioner

WARNING: The air conditioner refrigerant circuit must not be opened.

NOTE:

- **The refrigerant circuit can only be opened in workshops having specially trained personnel and the necessary tools and workshop equipment.**
- **To prevent damage to condenser and also to the refrigerant lines/hoses, ensure that the lines and hoses are not stretched, kinked or bent.**

To facilitate removing and installing the engine without opening the refrigerant circuit:

- Remove retaining clamp(s) from refrigerant pipes.

- Remove ribbed belt. See **RIBBED BELT TENSIONER, REMOVING AND INSTALLING** .
- Remove air conditioner compressor, leaving refrigerant hoses connnected.

  See **COMPRESSOR** .

- Secure air conditioner compressor to towing eye so that refrigerant hoses/lines are not under tension.

NOTE: To prevent damage to bumper protect with adhesive tape.

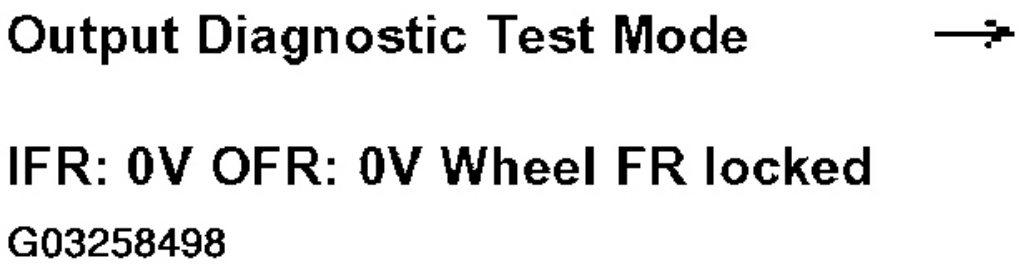

Fig. 23: Securing Air Conditioner Compressor To Towing Eye
Courtesy of VOLKSWAGEN OF AMERICA, INC.

ENGINE - CRANKSHAFT, CYLINDER BLOCK

ENGINE, DISASSEMBLING AND ASSEMBLING

NOTE:

- **When stripping and assembling the engine it should be secured to the engine frar with engine and transmission bracket VW540 and supplementary set VW 540/1B.**
- **If large amounts of material (as metallic particles and abrasive fragments) remove by a cutting or grinding tool or wear are discovered during engine repair work, thi can be from damage to the crankshaft or connecting rod bearings due to partial seizure or oil loss. To prevent any further damage from occurring, carry out the following once the repair procedure is complete:**
  - **Thoroughly clean oil channels**
  - **Replace oil spray jets**
  - **Replace oil cooler**
  - **Replace oil filter**

I. See PART I

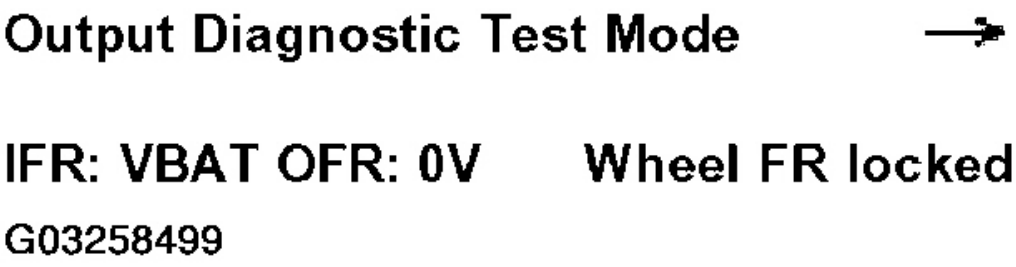

Fig. 24: Disassembling And Assembling Engine
Courtesy of VOLKSWAGEN OF AMERICA, INC.

II. See PART II

PART I

NOTE: The following list refers to items in Fig. 25 .

1. **25 N.m**
2. **Tensioning device for ribbed belt**
   - Turn with open-end spanner to loosen ribbed belt. See **RIBBED BELT TENSIONER, REMOVING AND INSTALLING**
3. **Toothed belt guard - upper part**
4. **Toothed belt guard - center section**
5. **27 N.m**
6. **Idler wheel**
7. **Tensioning roller**
8. **Toothed belt**
   - Mark direction of travel before removing
   - Check for wear
   - Do not kink
   - Removing, installing and tensioning. See **TOOTHED BELT, REMOVING, INSTALLING AND TENSIONING**
9. **Coolant pump**
   - Removing and installing. See **COOLANT PUMP, REMOVING AND INSTALLING**
10. **O-Ring**
    - Always replace if damaged

11. **15 N.m**
12. **Tensioner for toothed belt**
13. **Crankshaft toothed belt sprocket**
14. **15 N.m**
15. **20 N.m**
16. **90 N.m + 1/4 turn (90°) further**
    - Always replace
    - Counter-hold with 3099 to loosen and tighten
    - When bolting on, place two washers between toothed belt pulley and counter-hold
17. **Toothed belt guard - lower part**
18. **10 N.m**
    - Insert with locking fluid D 000 600 A2
19. **Pulley**
    - For power assisted steering pump
20. **25 N.m**
21. **Ribbed belt**
    - Mark direction of rotation before removing
    - Removing and installing. See **RIBBED BELT TENSIONER, REMOVING AND INSTALLING**
22. **25 N.m**
23. **Belt pulley/vibration damper**
    - Can only be installed in one position (holes are offset)
    - Note position when installing toothed belt **TOOTHED BELT, REMOVING, INSTALLING AND TENSIONING**

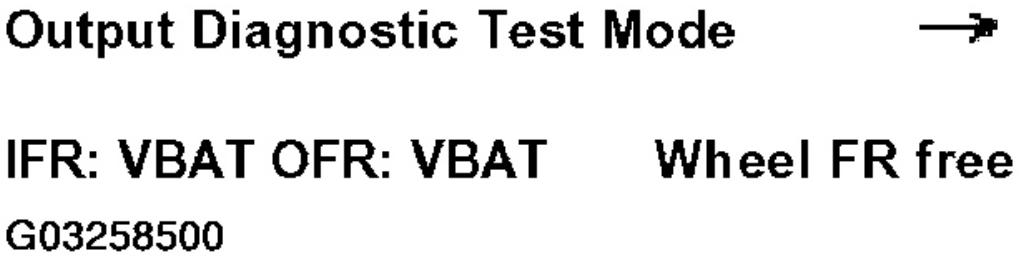

Fig. 25: Exploded View Of Engine (Front Engine Components - Part I
Courtesy of VOLKSWAGEN OF AMERICA, INC.

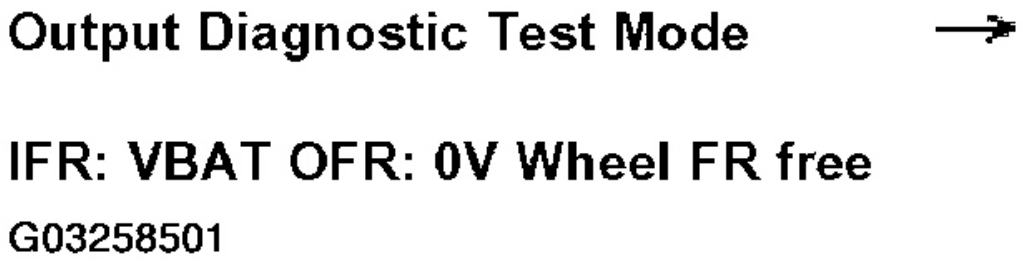

Fig. 26: Exploded View Of Engine (Cylinder Block Components) - Part II
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: The following list refers to items in Fig. 26 .

1. **Knock sensor 1 -G61-**
   - Checking:

     See **DTC MEMORY OF MOTRONIC ENGINE CONTROL MODULE, CHECKING AND ERASING**

2. **20 N.m**
   - Tightening torque influences function of knock sensor
3. **Knock sensor 2 -G66-**
   - Checking:

     See **GENERAL INFORMATION FOR ON BOARD DIAGNOSTIC (OBD)**

4. **Dipstick**
   - Oil level must not be above the max. mark!
5. **Guide**
   - For dipstick
6. **O-Ring**
   - Always replace
7. **Coolant pipe**
8. **20 N.m**
9. **Oil filter bracket**

- Disassembling and assembling. See **PART II**

10. **15 N.m + 1/4 turn (90°) further**
    - Always replace
11. **Oil cooler**
    - Coat contact area to flange, outside the seal, with AMV188 100 02
    - Ensure clearance to adjacent components
    - Note. See **ENGINE, DISASSEMBLING AND ASSEMBLING**
12. **25 N.m**
13. **Oil filter**
    - Loosen with strap wrench
    - Tighten by hand
    - Note instructions on filter when installing
14. **Gasket**
    - Always replace
15. **10 N.m**
16. **Engine speed sender**
    - Checking:

      See **GENERAL INFORMATION FOR ON BOARD DIAGNOSTIC (OBD)**

17. **Connection**
18. **15 N.m**
19. **O-Ring**
    - Always replace
20. **Coolant thermostat**
    - Checking: heat-up thermostat in water
    - Opening commences approx. 86°C
    - Opening lift min. 7 mm
    - Removing and installing. See **THERMOSTAT, REMOVING AND INSTALLING**
    - Observe installation position. See **THERMOSTAT, REMOVING AND INSTALLING**
    - Checking: heat-up thermostat in water
21. **45 N.m**
22. **Compact bracket**
    - For ribbed belt tensioning roller, alternator, power steering pump and air conditioning compressor
23. **Right engine bracket**

Ribbed belt tensioner, removing and installing

Special Tools And Equipment

- 3090 Connecting rod support

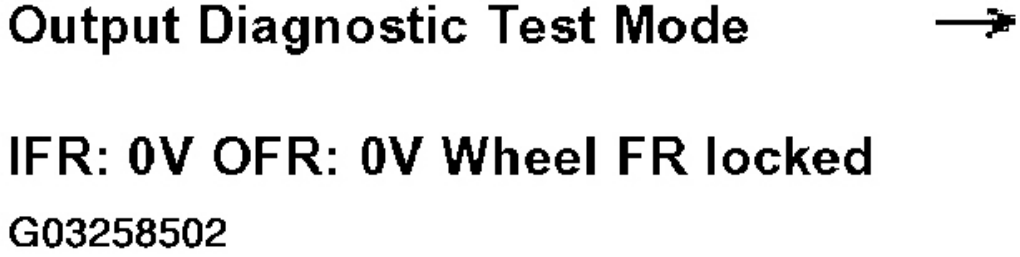

Fig. 27: Identifying 3090 Connecting Rod Support
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Removing ribbed belt

- Mark direction of rotation of ribbed belt.
- To loosen ribbed belt turn tensioning element in direction of arrow.

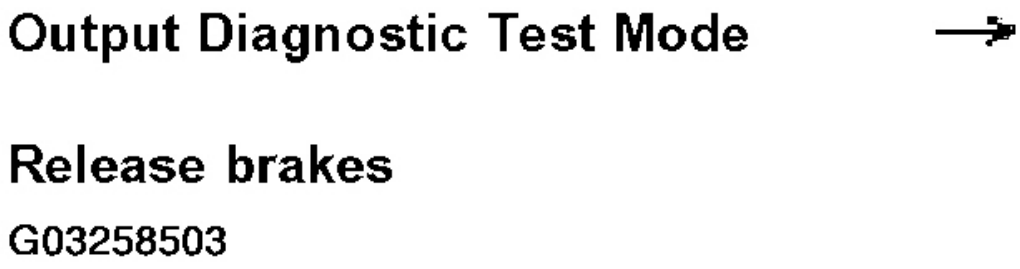

Fig. 28: Loosening Ribbed Belt By Turning Tensioning Element In Direction Of Arrow
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Lock tensioning device with 3090 Connecting rod support.

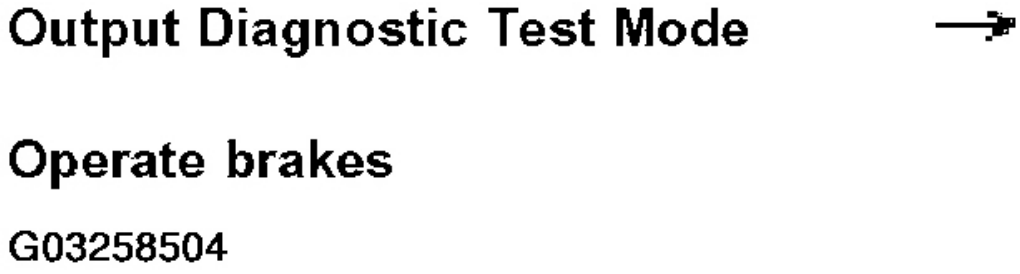

Fig. 29: Identifying Lock Tensioning Device With 3090 Connecting Rod Support
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove or install ribbed belt.

NOTE: When installing ribbed belts ensure the belt seats correctly in the belt pulley.

- Remove insulation tray.

See **PLENUM CHAMBER INNER COVER, REMOVING AND INSTALLING**

- Remove or install ribbed belt.
- Start engine and check belt running.

Ribbed belt routing

Belt drive without air conditioning compressor

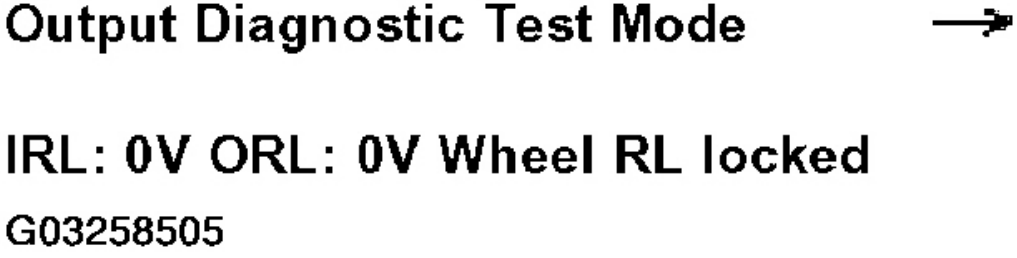

Fig. 30: Identifying Belt Drive Without Air Conditioning Compressor
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Belt drive with air conditioning compressor

NOTE: Engines with an air conditioning compressor are equipped with a double ribbed belt.

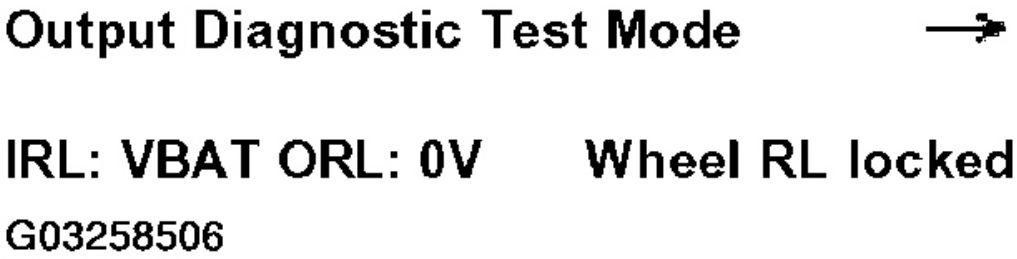

Fig. 31: Identifying Belt Drive With Air Conditioning Compressor
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Toothed belt, removing, installing and tensioning

Special tools, workshop equipment, test and measuring appliances and aux. items required

- 10-222A Engine support bracket with 10-222A/8 adapter
- 3180 Retainer (for turbocharged engines)
- T10092 Tensioning bolt

- T40011 Locking pin
- VAG1331 Torque wrench (5 to 50 N.m)
- V.A.G 1332 Torque wrench (40 to 200 N.m)
- D 000 600A2 Locking fluid

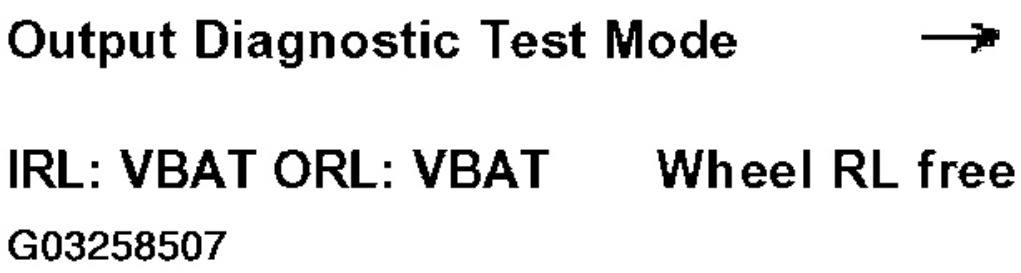

Fig. 32: Identifying Special Tools
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Removing

- Note safety precautions before starting work. See **SAFETY PRECAUTIONS WHEN WORKING ON FUEL SUPPLY**
- Observe rules for cleanliness. See **RULES OF CLEANLINESS** .
- Remove engine cover.
- Remove right-hand insulation tray.

  See **PLENUM CHAMBER INNER COVER, REMOVING AND INSTALLING**

- Remove air duct to charge air cooler at bottom right of long member.

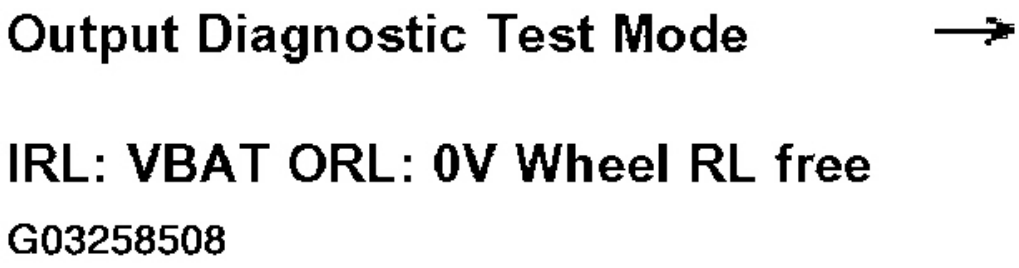

Fig. 33: Removing Air Duct To Charge Air Cooler At Bottom Right Of Long Member
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove ribbed belt. See **RIBBED BELT TENSIONER, REMOVING AND INSTALLING** .
- Remove tensioning element for ribbed belt.

Engine installed:

- Turn crankshaft to TDC No.1 cylinder (vehicles with manual transmission).

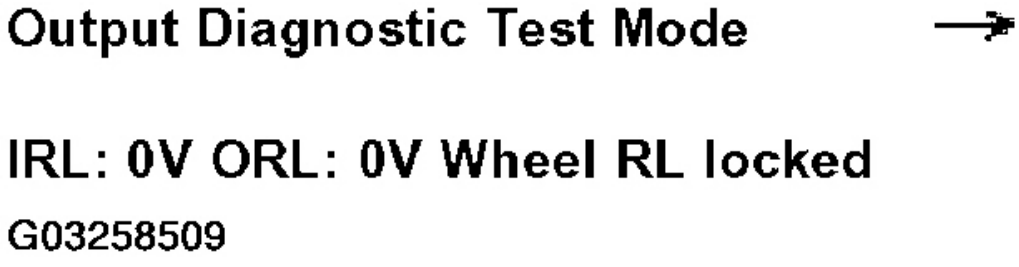

Fig. 34: Turning Crankshaft To TDC No.1 Cylinder (Manual Transmission)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Turn crankshaft to TDC No.1 cylinder (vehicles with automatic transmission).

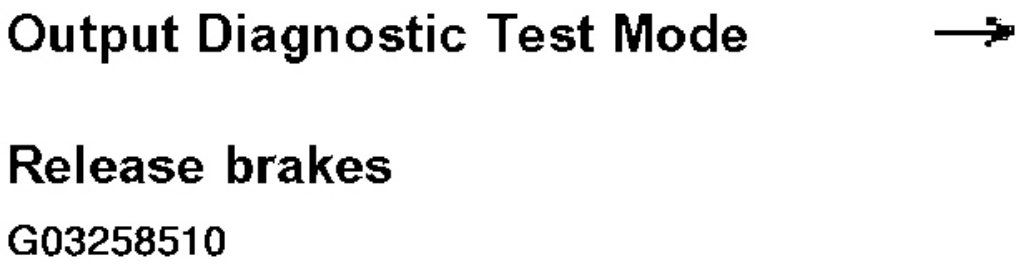

Fig. 35: Turning Crankshaft To TDC No.1 Cylinder (Automatic Transmission)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

With engine removed:

- Turn vibration damper to TDC No. 1 cylinder -arrows-.

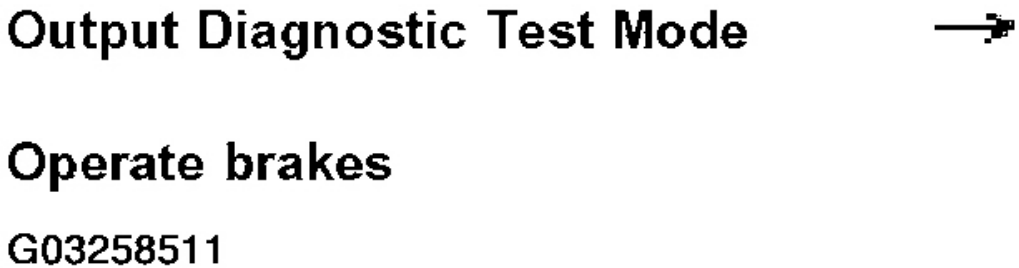

Fig. 36: Turning Vibration Damper To TDC No. 1 Cylinder
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove coolant expansion tank and place to side.
- Pull off vacuum pipes at EVAP canister and at throttle valve housing.
- Remove toothed belt guard (upper part).
- Install engine support bracket 10-222A with legs 10-222A/1.

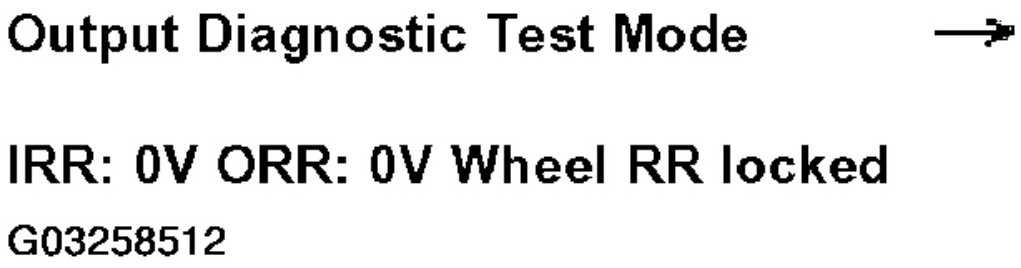

Fig. 37: Installing Engine Support Bracket 10-222A With Legs 10-222A/1
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Locate bracket 3180 in lifting eye on cylinder head and take-up weight of engine.
- Remove securing bolts from assembly mount/engine mount, assembly mount/body and assembly mount/body mount -arrows- and remove assembly mount complete.

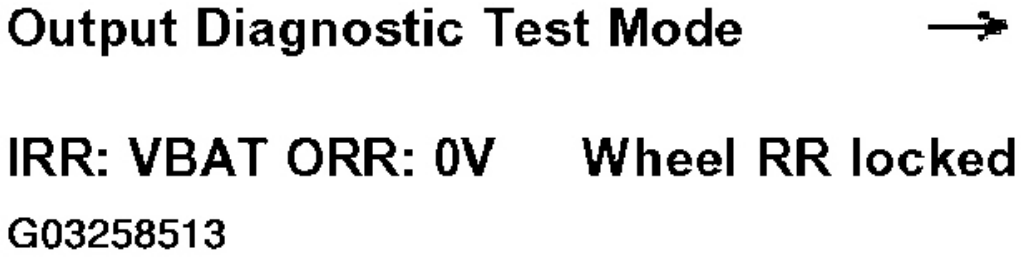

Fig. 38: Assembly Mount/Body Mount Bolts
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove vibration damper/belt pulley.
- Remove lower and center toothed belt guard.

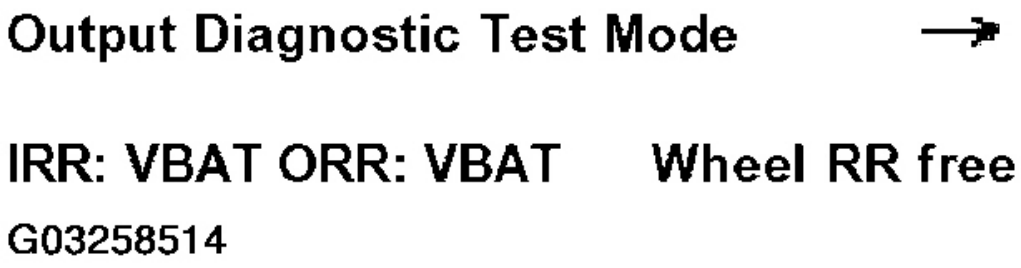

Fig. 39: Removing Vibration Damper/Belt Pulley
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove engine bracket from cylinder block.

NOTE: When loosening the front engine mount bolt the engine must be raised slightly with the support bracket.

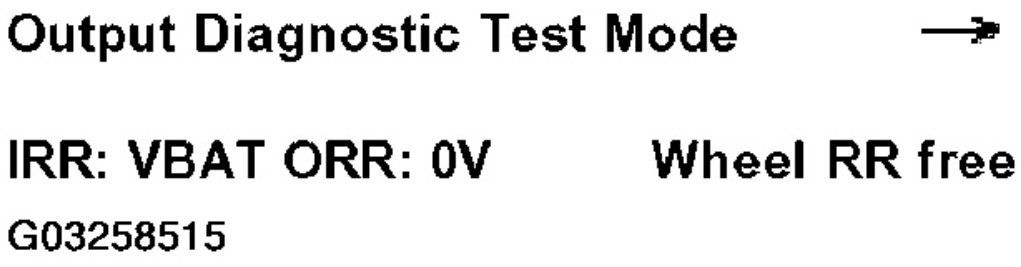

Fig. 40: Removing Engine Bracket From Cylinder Block
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Mark direction of rotation of toothed belt.
- Screw tensioning bolt T10092 into toothed belt tensioning element.

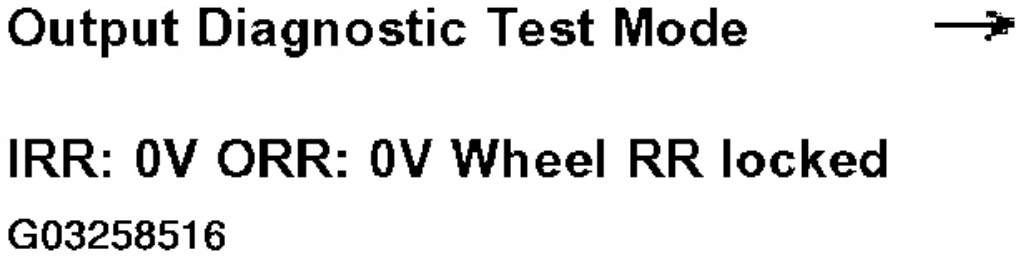

Fig. 41: Screwing Tensioning Bolt T10092 Into Toothed Belt Tensioning Element
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Align pressure piston using pointed pliers or wire before tensioning (hole in pressure piston must align with hole in housing).
- Tension piston of tensioning element just enough that the piston can be locked with locking pin T40011.
- Remove toothed belt.
- Turn crankshaft back slightly.

Installing

NOTE: When turning the camshaft the crankshaft must not be at TDC (danger of damage valves/piston crown).

A - Toothed belt completely removed

If toothed belt has only been removed from camshaft. See **B - TOOTHED BELT ONLY TAKEN OFF CAMSHAFT SPROCKET** .

Conditions

- The pistons must not be positioned at TDC

Work sequence

- Bring mark on camshaft in line with the mark on cylinder head cover.

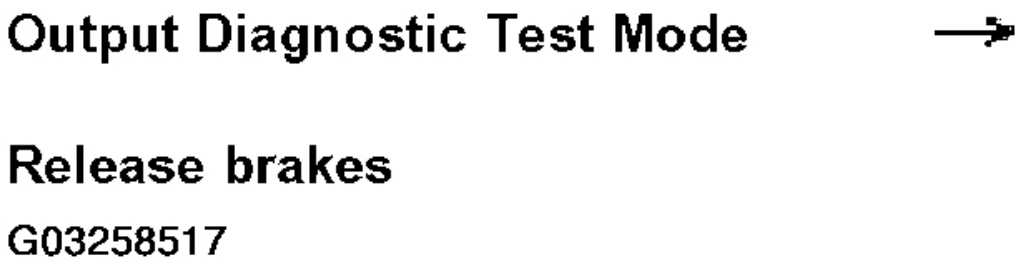

Fig. 42: Aligning Mark On Camshaft With The Mark On Cylinder Head Cover
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Place toothed belt on crankshaft sprocket (observe direction of rotation).
- Install engine mount to cylinder block.

  Tightening torque: 45 N.m

NOTE: Before installing engine mount, insert bolts into mount.

- Install lower part of toothed belt guard. Insert securing bolts with locking fluid "D 000 600 A2".

  Tightening torque: 10 N.m

- Secure vibration damper/belt pulley with one bolt (note fixing arrangement).
- Turn crankshaft to TDC No. 1 cylinder.

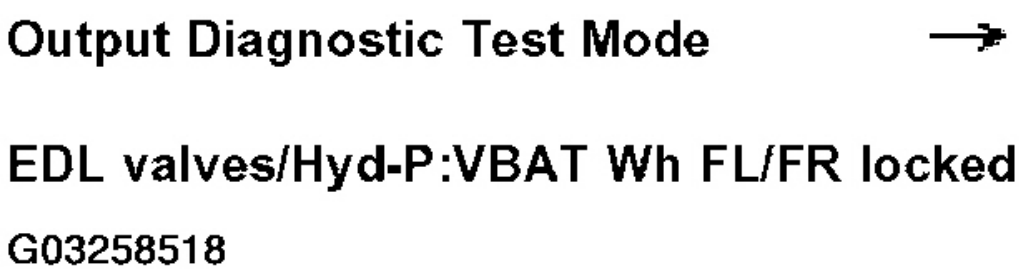

Fig. 43: Turning Crankshaft To TDC No. 1 Cylinder

Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Install toothed belt onto coolant pump, tensioning roller and camshaft sprocket.
- Tighten toothed belt. See **TENSIONING TOOTHED BELT** .

B - Toothed belt only taken off camshaft sprocket

- Bring mark on camshaft in line with the mark on cylinder head cover.

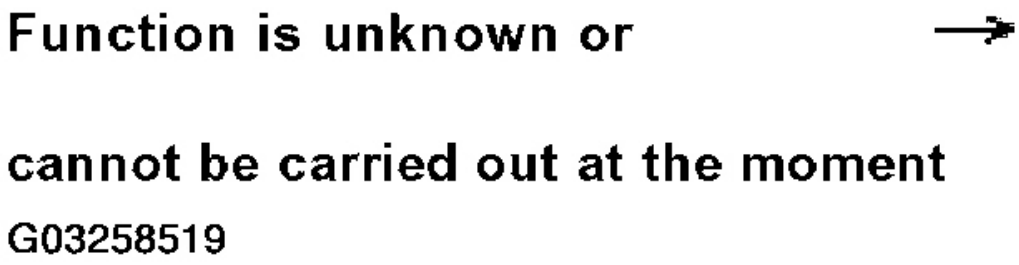

Fig. 44: Aligning Mark On Camshaft With The Mark On Cylinder Head Cover
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Turn crankshaft to TDC No. 1 cylinder.
- Install toothed belt onto camshaft sprocket.
- Tighten toothed belt. See **TENSIONING TOOTHED BELT**

Tensioning toothed belt

- Tension toothed belt by pulling out locking pin T40011 and removing tensioning bolt T10092.

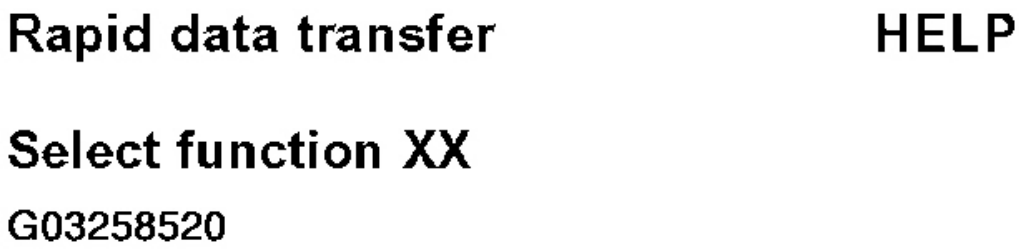

Fig. 45: Tensioning Toothed Belt By Pulling Out Locking Pin T40011 And Removing Tensioning Bolt T10092
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Turn crankshaft two full turns and check whether camshaft and crankshaft marks align with their reference points.
- Install vibration damper/belt pulley

  Tightening torque: 25 N.m

- Install center part of toothed belt guard. (Insert securing bolts with locking fluid D 000 600 A2).

  Tightening torque: 10 N.m

- Install upper toothed belt guard.
- Install aggregate mount and engine mount. Tightening torque. See **ENGINE/TRANSMISSION MOUNTS** .
- Install ribbed belt tensioner.

  Tightening torque: 25 N.m

- Install ribbed belt. See **RIBBED BELT TENSIONER, REMOVING AND INSTALLING** .
- Install air duct to charge air cooler at bottom right of long member.
- Install right-hand insulation tray

  See **PLENUM CHAMBER INNER COVER, REMOVING AND INSTALLING**

SEALING FLANGES AND DRIVE PLATE, REMOVING AND INSTALLING

NOTE: For repairs to the clutch:

For 02J, see CLUTCH ASSEMBLY

For 02M, see CLUTCH ASSEMBLY

NOTE: The following list refers to items in Fig. 46 .

1. **90 N.m + 1/4 turn (90°) further**
   - Always replace
   - Counter-hold with 3099 to loosen and tighten
   - Threads and shoulder must be free of oil and grease
   - When bolting on, place two washers between toothed belt pulley and counter-hold
2. **Crankshaft toothed belt sprocket**
3. **15 N.m**
4. **Oil seal**
   - Replacing. See **CRANKSHAFT OIL SEAL (BELT PULLEY END), REPLACING**
5. **Sealing flange**
   - Must be located on dowel sleeves
   - Removing and installing. See **FRONT SEALING FLANGE, REMOVING AND INSTALLING**
6. **Cylinder block**
   - Removing and installing crankshaft. See **CRANKSHAFT, REMOVING AND INSTALLING**
   - Disassembling and assembling pistons and connecting rods. See **PISTONS AND CONNECTING RODS, DISASSEMBLING AND ASSEMBLING**
7. **60 N.m + 1/4 turn (90°) further**
   - Always replace
8. **Flywheel/drive plate**
   - To remove and install flywheel counter-hold with 3067
   - Removing and installing drive plate. See **DRIVE PLATE, REMOVING AND INSTALLING**
9. **Intermediate plate**
   - Must be located on dowel sleeves
   - Do not damage/bend when assembling
10. **Sealing flange with oil seal**
    - Only replace complete
    - Remove oil pan to be able to remove and install. See **OIL PAN, REMOVING AND INSTALLING**
    - Install new sealing flange with fitting sleeve (before installing do not pull sealing sleeve out of oil seal)
    - Before installing, remove oil residue from crankshaft journal using a clean cloth
    - Do not additionally oil or grease the oil seal sealing lip
    - Use protective sleeve supplied when installing

- Remove protective sleeve first after sealing flange has been slid onto crankshaft journal
- Install new sealing flange with fitting sleeve (before installing do not pull sealing sleeve out of oil seal)

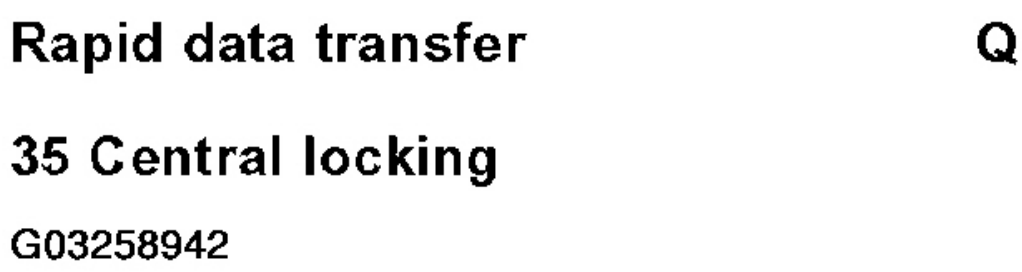

Fig. 46: Identifying Front And Rear Sealing Flanges And Drive Plate
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Crankshaft oil seal (belt pulley end), replacing

Special tools and equipment

- 3099 Counter-hold tool
- VAG 1331 Torque wrench (5-50 N.m)
- VAG 1332 Torque wrench (40-200 N.m)
- 3203 Oil seal extractor
- 2080 A Fitting sleeve
- 3265 Fitting sleeve

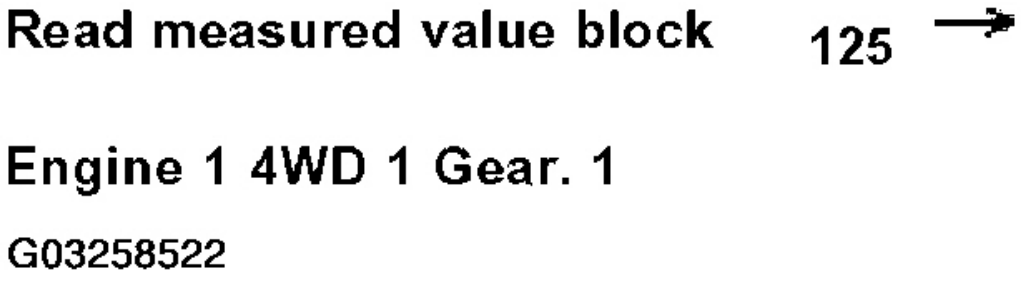

Fig. 47: Identifying Special Tools And Equipment
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Removing

- Remove ribbed belt and tensioning element. See **RIBBED BELT TENSIONER, REMOVING AND INSTALLING** .
- Remove toothed belt. See **REMOVING** .
- Remove crankshaft toothed belt sprocket. To do this counter-hold sprocket with 3099.

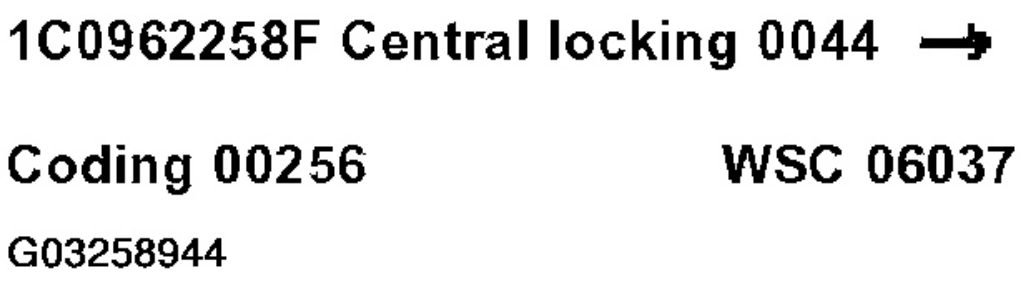

Fig. 48: Removing Crankshaft Toothed Belt Sprocket
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: When bolting on counter-hold place two washers between toothed belt pulley and counter-hold.

- To guide seal extractor, screw center bolt into crankshaft onto stop by hand.

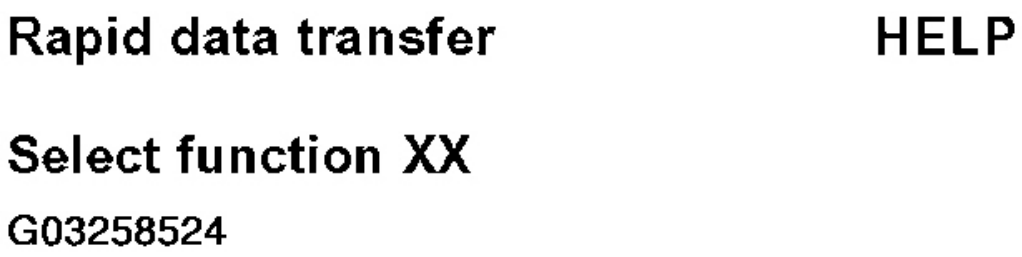

Fig. 49: Screwing Center Bolt Into Crankshaft Onto Stop By Hand
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Unscrew inner part of oil seal extractor 3203 nine turns (approx. 20 mm) out of outer part and lock with knurled screw.
- Lubricate threaded head of oil seal extractor 3203, place it in position and exerting firm pressure screw it as far as possible into oil seal.

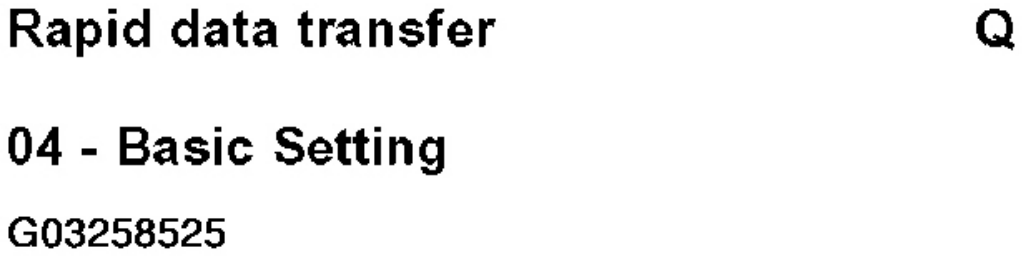

Fig. 50: Lubricating Threaded Head Of Oil Seal Extractor 3203 And Placing In Position And Exerting Firm Pressure Screw
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Loosen knurled screw and turn inner part against crankshaft until the oil seal is pulled out.

Installing

NOTE: Gradual introduction of PTFE oil seal (identifying characteristics: no annular spring, sealing lip wider). The sealing lip of this oil ring must not be oiled or lubricated. A plain encased seal of older construction (with annular spring) may

be replaced with a PTFE oil seal, but not vice versa.

- Install guide sleeve from 2080 A onto crankshaft journal.

Fig. 51: Installing Guide Sleeve From 2080 A Onto Crankshaft Journal
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Slide oil seal over guide sleeve onto crankshaft stub.
- Press in seal with press sleeve from 3265. To do this use old central bolt for crankshaft toothed belt sprocket.

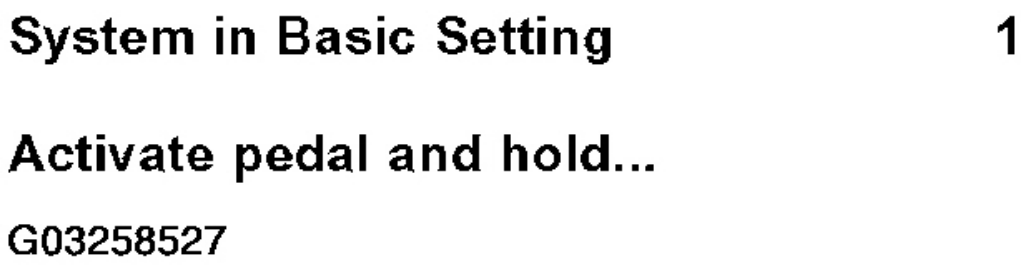

Fig. 52: Pressing In Seal With Press Sleeve From 3265
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press sleeve in onto stop.
- Install crankshaft toothed belt sprocket and hold with counter-hold tool 3099.

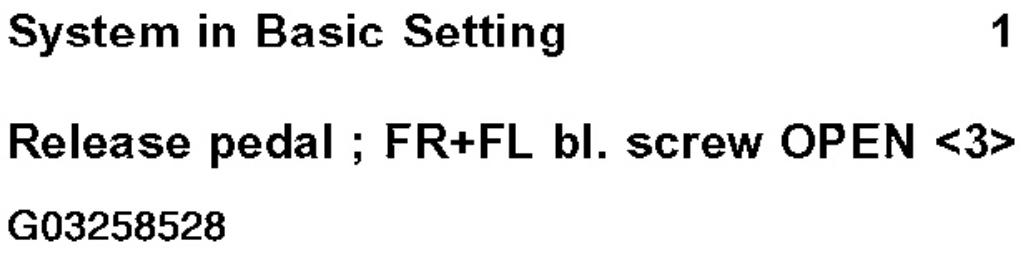

Fig. 53: Installing Crankshaft Toothed Belt Sprocket And Holding With Counter-Hold Tool 3099
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Tighten new central bolt to 90 N.m + 1/4 turn (90°) further.

NOTE:

- **When bolting on, place two washers between toothed belt pulley and counter-hold.**
- **Thread and shoulder must be free of oil and grease.**

- Install toothed belt and adjust valve timing. See **INSTALLING** .
- Install ribbed belt and tensioning element. See **RIBBED BELT TENSIONER, REMOVING AND INSTALLING** .

Front sealing flange, removing and installing

Special tools and equipment

- 3099 Counter-hold tool
- 2080 A Fitting sleeve
- VAG 1331 Torque wrench (5-50 N.m)
- VAG 1332 Torque wrench (40-200 N.m)
- D 176 404 A2 Silicone sealant
- Hand drill with plastic brush wheel
- Flat scraper
- Protective glasses

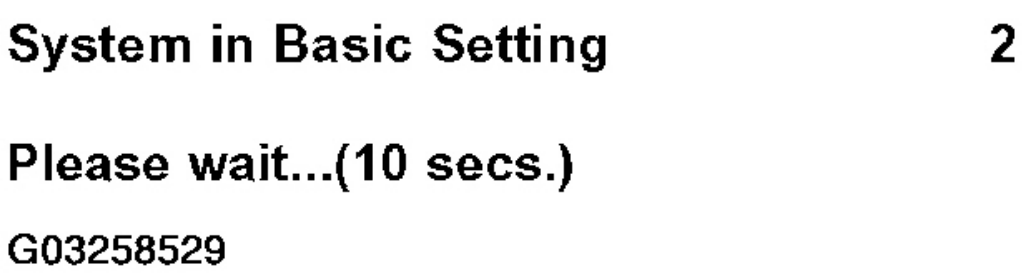

Fig. 54: Identifying Special Tools And Equipment
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Removing

- Remove ribbed belt and tensioning element. See **RIBBED BELT TENSIONER, REMOVING AND INSTALLING** .
- Remove toothed belt. See **REMOVING** .
- Remove crankshaft toothed belt sprocket. To do this counter-hold sprocket with 3099.

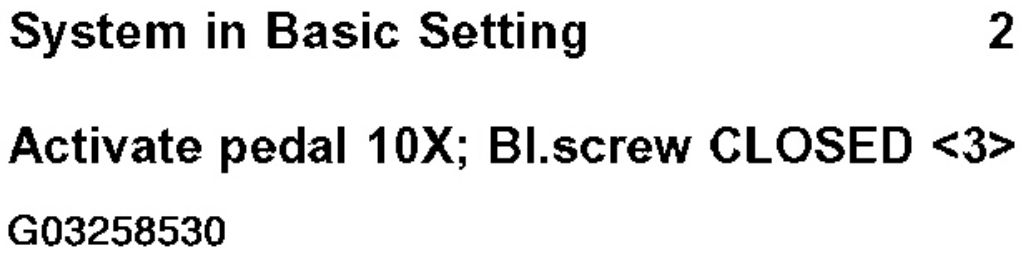

Fig. 55: Removing Crankshaft Toothed Belt Sprocket By Counter-Holding Sprocket With 3099
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: When bolting on, place two washers between toothed belt pulley and counter-hold.

- Remove oil pan. See **OIL PAN, REMOVING AND INSTALLING** .
- Unbolt front sealing flange.

- Take off sealing flange, release using light blows with a rubber headed hammer if necessary.
- Remove sealant residue on cylinder block with a flat scraper.
- Remove sealant remains on sealing flange with a rotating plastic brush (wear protective goggles).

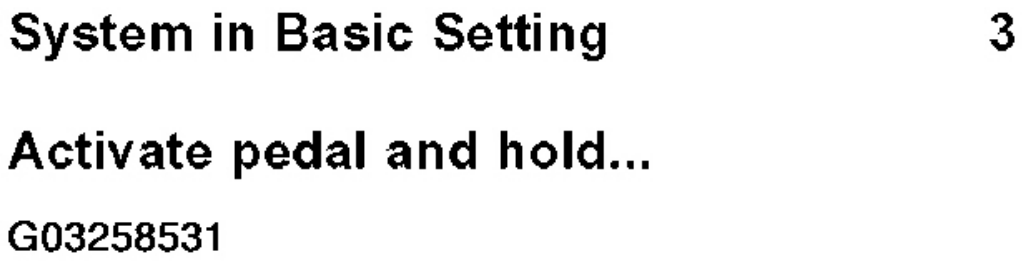

Fig. 56: Removing Sealant Remains On Sealing Flange With Rotating Plastic Brush
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Clean sealing surface, must be free of oil and grease.

Installing

NOTE:

- **Note the "use by" date of the sealant.**
- **The sealing flange must be installed within 5 minutes o applying the silicone sealant.**

- Cut-off tube nozzle at forward marking (nozzle approx. 3 mm diameter).
- Apply silicone sealing compound to clean oil pan sealing surface as shown.

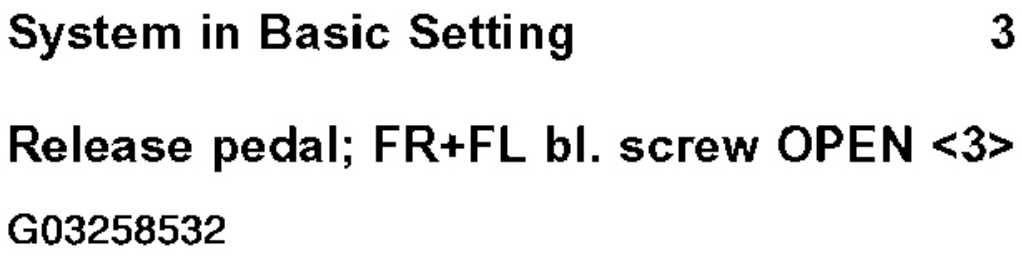

Fig. 57: Applying Silicone Sealing Compound To Clean Oil Pan Sealing Surface
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Thickness of sealant bead -arrows-: 2 - 3 mm

NOTE: The sealing compound bead must not be thicker, otherwise excessive sealing compound will enter the oil pan and may block the oil suction pipe strainer.

- Apply silicone sealant bead as shown to clean sealing surface of sealing flange.

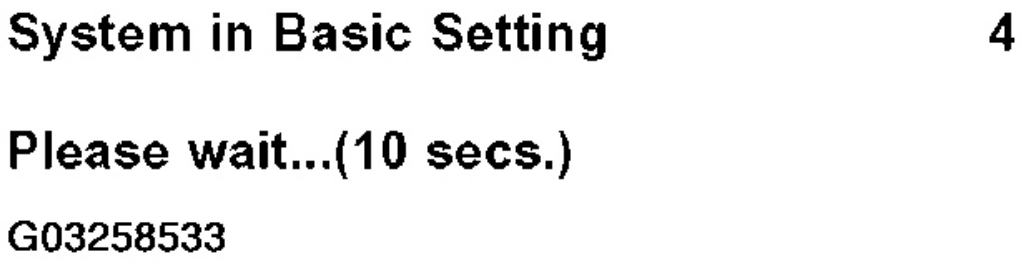

Fig. 58: Applying Silicone Sealant Bead To Clean Sealing Surface Of Sealing Flange
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Install sealing flange immediately and lightly tighten all bolts.

NOTE: Use guide sleeve from 2080A to install sealing flange with the oil seal already installed.

- Tighten sealing flange securing bolts using alternate sequence.

Tightening torque: 15 N.m

- Remove excess sealant.
- Install oil pan. See **OIL PAN, REMOVING AND INSTALLING** .

NOTE: After installing, the sealant must be allowed to dry for approx. 30 minutes before engine oil is filled.

- Install crankshaft toothed belt sprocket and hold with counter-hold tool 3099.

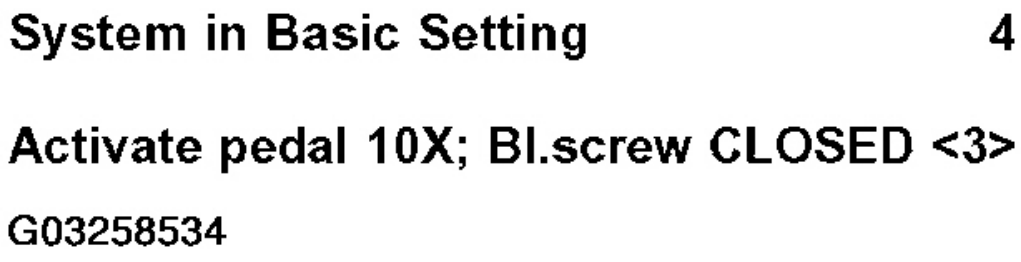

Fig. 59: Installing Crankshaft Toothed Belt Sprocket And Holding With Counter-Hold Tool 3099
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Tighten new central bolt to 90 N.m + 1/4 turn (90°) further.
- Install compact bracket including tightening element for ribbed V-belt. See) COMPACT BRACKET .

NOTE:

- **When bolting on, place two washers between toothed belt pulley and counter-hold.**
- **Thread and shoulder must be free of oil and grease.**

- Install toothed belt and adjust valve timing. See **INSTALLING** .
- Installing ribbed belt and tensioning element. See **RIBBED BELT TENSIONER, REMOVING AND INSTALLING** .

Drive plate, removing and installing

Special tools and equipment

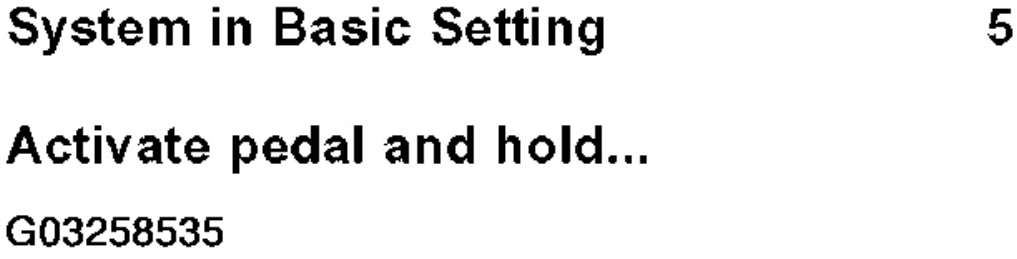

Fig. 60: Identifying VW 558 Retainer
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- VW 558 Retainer
- Hex bolt M8x45 and two M10 hex nuts
- Depth gauge

Loosening and tightening drive plate

- Secure counter-hold tool VW 558 to the drive plate with a hex bolt M8x45. Place two M10 hex nuts -1- between counter-hold tool and drive plate.

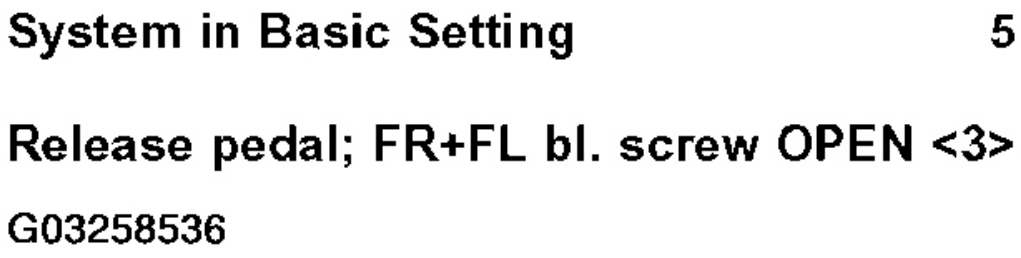

Fig. 61: Securing Counter-Hold Tool VW 558 To The Drive Plate With Hex Bolt M8x45
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Loosen drive plate bolts.

Installing drive plate

- Locate drive plate and packing plate with recesses -1-.
- Install new bolts -3- and tighten to 30 N.m.

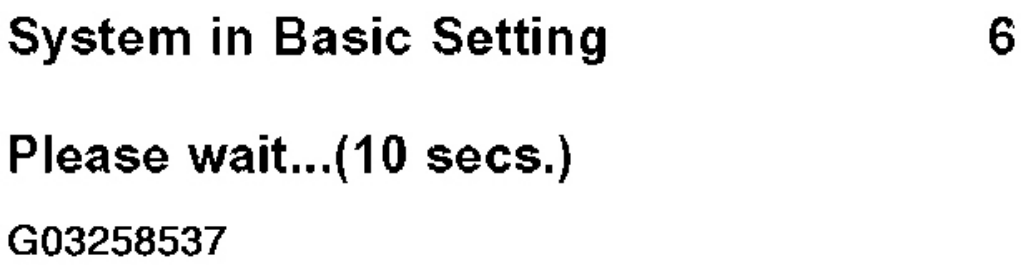

Fig. 62: Locating Drive Plate And Packing Plate With Recesses
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Check dimension -a- at three points and calculate average.

  Specification: 19.5 to 21.1 mm

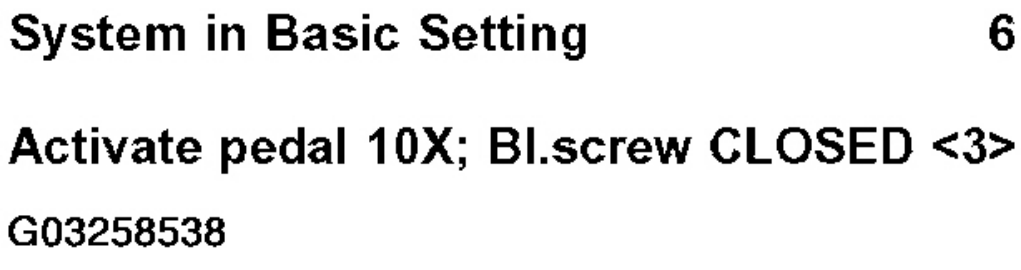

Fig. 63: Measuring Dimension Through Hole In Drive Plate To Milled Surface Of Cylinder Block
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: Measured through hole in drive plate to milled surface of cylinder block.

If the specification is not attained:

- Remove drive plate again and fit shim -2-. Tighten bolts again to 30 N.m.

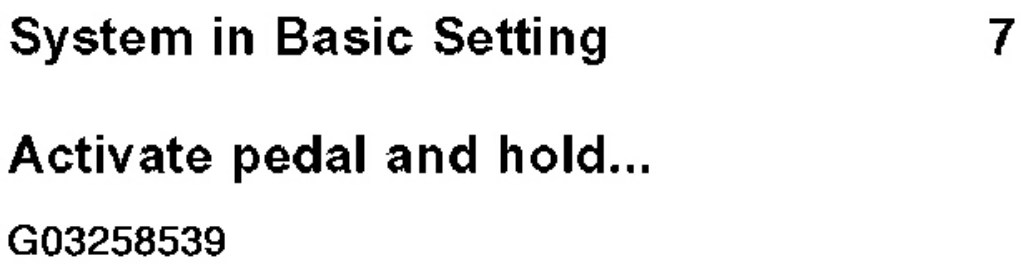

Fig. 64: Removing Drive Plate And Shim
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Tighten bolts to 60 N.m and turn 90° (1/4 turn) further (turning further can be done in several stages).

CRANKSHAFT, REMOVING AND INSTALLING

NOTE:

- **Before removing the crankshaft, prepare a suitable surface so that the sensor wheel (item 8) is not making contact with anything and is not damaged.**
- **When stripping and assembling the engine it should be secured to the engine frame with engine and transmission bracket VW 540 and supplementary set VW 540/1B.**

NOTE: The following list refers to items in Fig. 65 .

1. **Oil pump**
   - With pressure relieve valve of 12 bar
   - Before installing, check that both dowel sleeves for centering oil pump/cylinder head are installed
   - Removing and installing. See **LUBRICATION SYSTEM COMPONENTS, REMOVING AND INSTALLING**
2. **15 N.m**
3. **Chain sprocket**
   - For oil pump drive
   - Check for wear
4. **Bearing caps 1, 2, 4 and 5**
   - For bearing cap without oil groove
   - For cylinder block with oil groove
   - Do not interchange used bearing shells (mark)

- Classification for ordering replacement parts. See **Upper Crankshaft Bearing Identification**

5. **65 N.m + 90° (1/4 turn) further**
   - Replacing
   - Threaded along complete length (screw)
   - Tighten to 65 N.m when measuring radial clearance
6. **Bearing cap**
   - Bearing cap 1: pulley end
   - Bearing cap 3 with recesses for thrust washers
   - Bearing shell retaining lugs (cylinder block/bearing cap) must be on the same side
7. **Bearing shell 3**
   - For bearing cap without oil groove
   - For cylinder block with oil groove
   - Do not interchange used bearing shells (mark)
8. **Sensor wheel**
   - Always replace
   - For engine speed (RPM) sensor -G28-
   - Can only be installed in one position (holes are offset)
9. **10 N.m + 1/4 turn (90°) further**
   - Always replace
10. **Thrust washer**
    - For bearing 3 bearing cap
    - Note fixing arrangement
11. **Crankshaft**

    Axial clearance:

    - New: 0.07-0.23 mm
    - Wear limit: 0.30 mm

    Checking radial clearance with Plastigage:

    - New: 0.01-0.04 mm
    - Wear limit: 0.15 mm
    - Do not rotate the crankshaft when checking the radial clearance
    - Crankshaft dimensions. See **CRANKSHAFT DIMENSIONS**

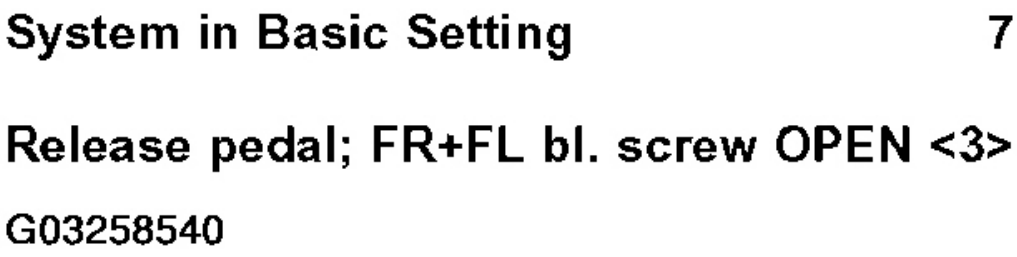

Fig. 65: Exploded View Of Crankshaft Assembly & Oil Pump
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Upper Crankshaft Bearing Identification

Vehicles from approx. 05.00

The upper crankshaft bearings are installed with the proper thickness bearing shells from the factory. Color points are used to identify the bearing shell thickness.

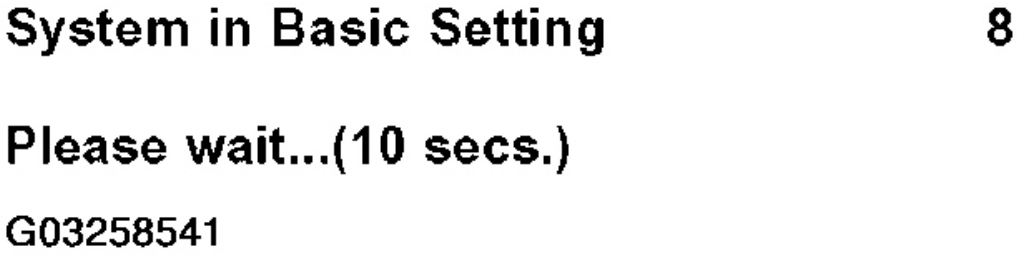

Fig. 66: Identifying Upper Crankshaft Bearing Identification Markings On Cylinder Block
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: The arrow shows drive direction.

Letters in the lower sealing surface of the cylinder block identify which bearing thickness must be installed at which position.

Color markings

CRANKSHAFT BEARING COLOR MARKINGS

Letter in cylinder block	Bearing color
S =	black
R =	red
G =	yellow

The lower crankshaft bearing shells are always supplied as a replacement part with the color marking "yellow".

Crankshaft dimensions

(in mm)

CRANKSHAFT DIMENSIONS

Honing dimension	Main journal diameter (mm)	Connecting rod journal diameter (mm)
Basic dimension	-0.017 54.00 -0.037	-0.022 47.80 -0.042
1st undersize	-0.017 53.75 -0.037	-0.022 47.55 -0.042
2nd undersize	-0.017 53.50 -0.037	-0.022 47.30 -0.042
3rd undersize	-0.017 53.25 -0.037	-0.022 47.05 -0.042

PISTONS AND CONNECTING RODS, DISASSEMBLING AND ASSEMBLING

Vehicles with engine code APH

For vehicles with engine code AWP or AWV, see **VEHICLES WITH ENGINE CODE AWP, AWV** .

NOTE: Secure engine to engine bracket VW 540 on assembly stand when dissembling/assembling engine.

NOTE: The following list refers to items in Fig. 67 .

1. **Piston ring**
   - Offset gaps by 120°
   - Remove and install with piston ring pliers
   - "TOP" faces toward piston crown
   - Checking ring gap. See **Checking Piston Ring Gap**

- Checking ring to groove clearance. See **Checking Ring To Groove Clearance**
- 2 or 3 part oil scraper ring, mixed installations permissible

2. **Piston**
   - Checking. See **Checking Piston**
   - Mark installation position and cylinder number
   - Arrow on piston crown points to pulley end
   - Install using piston ring clamp
3. **Connecting rod**
   - Only replace as a set
   - Mark cylinder number -B-
   - Installation position: Marking -A- faces toward pulley end
4. **Connecting rod bearing cap**
   - Note installation position
   - Installation position: Marking -A- faces towards pulley end
   - Mark cylinder number -B-
5. **30 N.m + 1/4 turn (90°) further**
   - Always replace
   - Oil threads and contact surface
   - To measure radial clearance tighten to 30 N.m but not further
6. **Pressure relief valve, 27 N.m**
   - Opening pressure: 1.3 to 1.6 bar
7. **Oil spray jet**
   - For piston cooling
8. **Bearing shell**
   - Note installation position
   - Do not interchange used bearing shells
   - Ensure retaining lugs fit tightly in recesses
   - Axial clearance New: 0.10-0.31 mm Wear limit: 0.40 mm

     Check radial clearance with Plastigage:

   - New: 0.01-0.05 mm
   - Wear limit: 0.09 mm
   - Do not rotate crankshaft when checking radial clearance
9. **Cylinder block**
   - Checking cylinder bores. See **Checking Cylinder Bores**
   - Piston and cylinder dimensions. See **PISTON AND CYLINDER DIMENSIONS (ENGINE CODE: APH)**

10. **Connecting rod bolt**
    - Always replace
11. **Circlip**
12. **Piston pin**
    - If difficult to remove, heat piston to 60° C
    - Remove and install with VW 222a

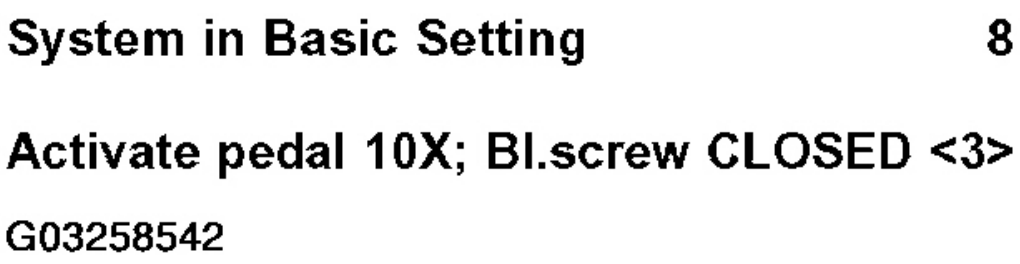

Fig. 67: Exploded View Of Pistons And Connecting Rods (Engine Code APH)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Checking Piston Ring Gap

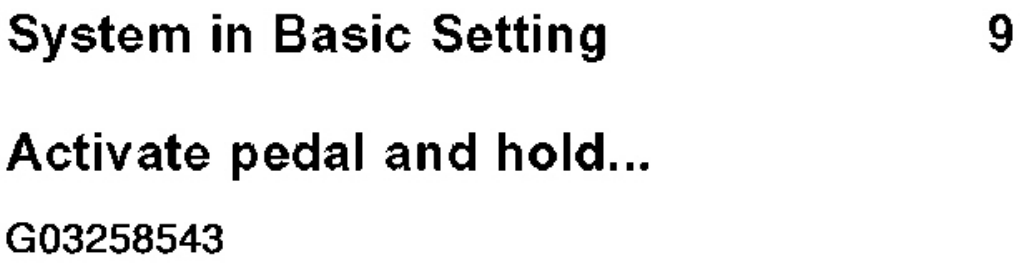

Fig. 68: Checking Piston Ring End Gap
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Special tools and equipment

- Feeler gauges

- Push ring squarely from above down to approx. 15 mm from bottom end of cylinder.

PISTON RING END GAP (ENGINE CODE APH)

Piston ring	Gap	
New		Wear limit
Compression mm rings	0.15-0.40	0.8
Oil scraper ring mm	0.25-0.50	1.0

Checking Ring To Groove Clearance

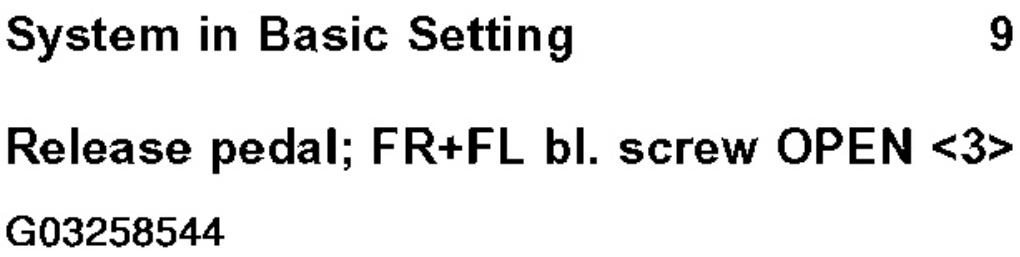

Fig. 69: Checking Ring To Groove Clearance
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Special tools and equipment

- Feeler gauges
- Clean groove before check.

PISTON RING-TO-GROOVE CLEARANCE (ENGINE CODE APH)

	Clearance	
Piston ring	New	Wear limit
Compression rings mm	0.02-0.07	0.12
Oil scraper ring mm	0.02-0.06	0.12

Checking Piston

Special tools and equipment

- Micrometer 75-100 mm
- Measure pistons approx. 10 mm from lower edge of skirt, at 90° to piston pin axis.

Deviation from nominal dimension max.: 0.04 mm

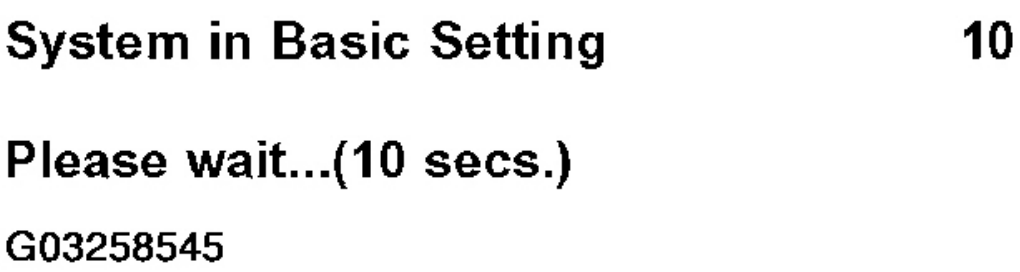

Fig. 70: Checking Piston Skirt Diameter
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Checking Cylinder Bores

Special tools and equipment

- Internal dial indicator 50-100 mm
- Measure bores at 3 locations in both directions -A- across engine and -B- in line with crankshaft.

  Deviation from nominal dimension max.: 0.10 mm

NOTE: Measuring the cylinder bores must not be done when the cylinder block is mounted on a repair stand with adapter bracket VW 540, as incorrect measurements would then be possible.

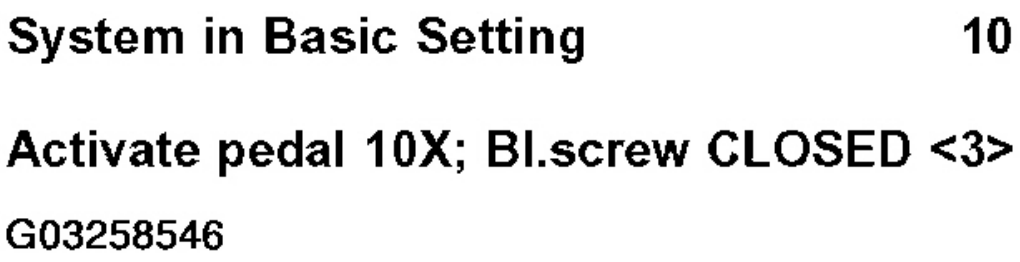

Fig. 71: Checking Cylinder Bores
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Piston and cylinder dimensions (engine code: APH)

PISTON AND CYLINDER DIMENSIONS (ENGINE CODE APH)

Honing dimension	Piston diameter	Cylinder bore diameter
Basic dimen. mm	80.965 (1)	81.01
1st oversize mm	81.465 (1)	81.51
(1) Dimension without graphite coating (thickness 0.02 mm). The graphite coating wears away.		

Vehicles with engine code AWP, AWV

NOTE: The following list refers to items in Fig. 72 .

1. **Piston ring**
   - Offset gaps by 120°
   - Remove and install with piston ring pliers
   - "TOP" faces toward piston crown
   - Checking ring gap. See **Checking Piston Ring Gap**
   - Checking ring to groove clearance. See **Checking Ring To Groove Clearance**
2. **Piston**
   - Checking. See **Checking Piston**
   - Mark installation position and cylinder number
   - Arrow on piston crown points to pulley end
   - Install using piston ring clamp
3. **Piston pin**
   - If difficult to remove, heat piston to 60 °C
   - Remove and install with VW 222a
4. **Circlip**
5. **Connecting rod**
   - Only replace as a set
   - Mark cylinder number -B-
   - Installation position: Marking -A- faces toward pulley end
6. **Bearing shell**
   - Note installation position
   - Do not interchange used bearing shells
   - Axial clearance

New: 0.05 to 0.31 mm

Wear limit: 0.37 mm

- Check radial clearance with Plastigage:

  New: 0.01 to 0.06 mm

  Wear limit: 0.09 mm

- Do not rotate crankshaft when checking radial clearance

7. **Cylinder block**
   - Checking cylinder bores. See **Bearing Shells - Mount**
   - Piston and cylinder dimensions. See **PISTON AND CYLINDER DIMENSIONS (ENGINE CODES: AWP, AWV)**
8. **Connecting rod bearing cap**
   - Note installation position
9. **Oil spray jet**
   - For piston cooling
10. **Pressure relief valve, 27 N.m**
    - Opening pressure: 1.3 to 1.6 bar
11. **Connecting rod bolt, 30 N.m + 1/4 turn (90°) further**
    - Always replace
    - Oil threads and contact surface
    - To measure radial clearance use old bolts
    - To measure radial clearance tighten to 30 N.m but not further

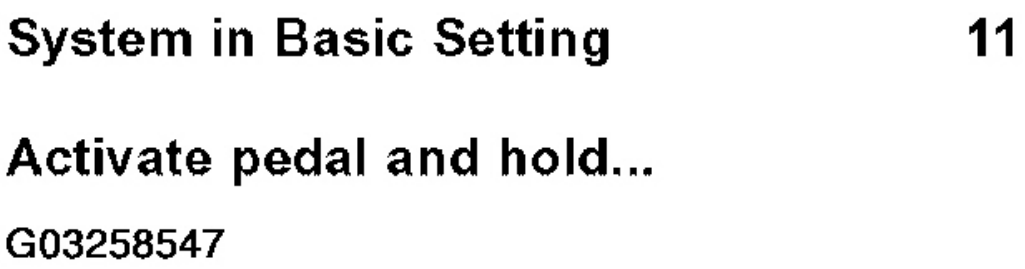

Fig. 72: Identifying Piston Components - Vehicles With Engine Code AWP, AWV
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Checking Piston Ring Gap

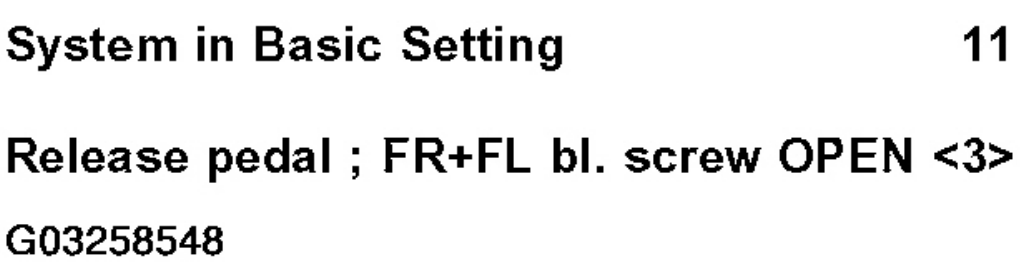

Fig. 73: Checking Piston Ring End Gap
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Special tools and equipment

- Feeler gauges
- Push ring squarely from above down to approx. 15 mm from bottom end of cylinder.

PISTON RING END GAP (ENGINE CODE AWP, AWV)

Piston ring	Gap	
	New	Wear limit
Compression rings mm	0.20 to 0.40	0.8
Oil scraper ring mm	0.25 to 0.50	0.8

Checking Ring To Groove Clearance

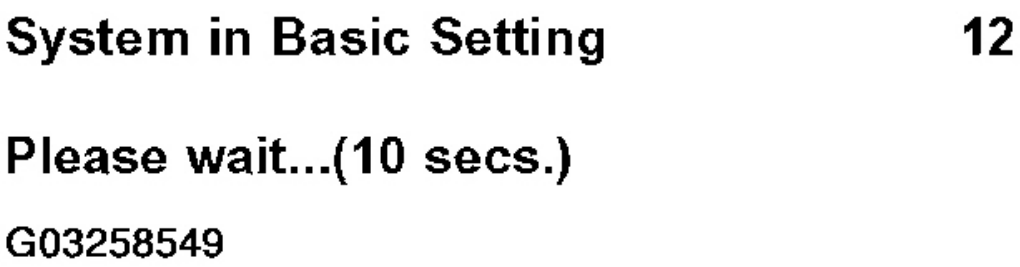

Fig. 74: Checking Ring To Groove Clearance
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Special tools and equipment

- Feeler gauges

Clean groove before check.

PISTON RING CLEARANCE (ENGINE CODE AWP, AWV)

Piston ring	Clearance	
	New	Wear limit
Compression rings mm	0.06 to 0.09	0.20
Oil scraper ring mm	0.03 to 0.06	0.15

Checking Piston

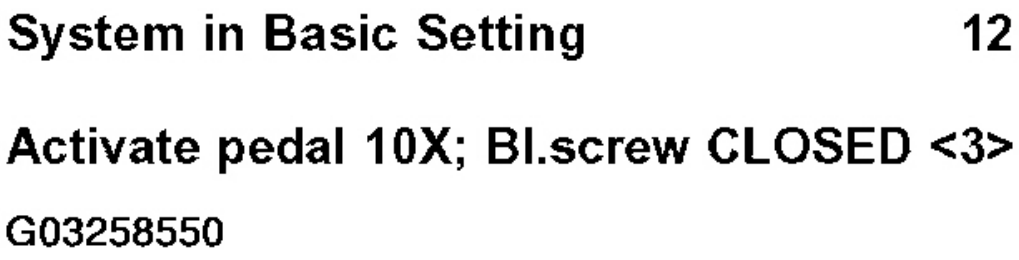

Fig. 75: Checking Piston Skirt Diameter (Engine Code AWP, AWV)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Special tools and equipment

- Micrometer 75 to 100 mm
- Measure pistons approx. 10 mm from lower edge of skirt, at 90° to piston pin axis.

  Deviation from nominal dimension: max. 0.04 mm

Bearing Shells - Mount

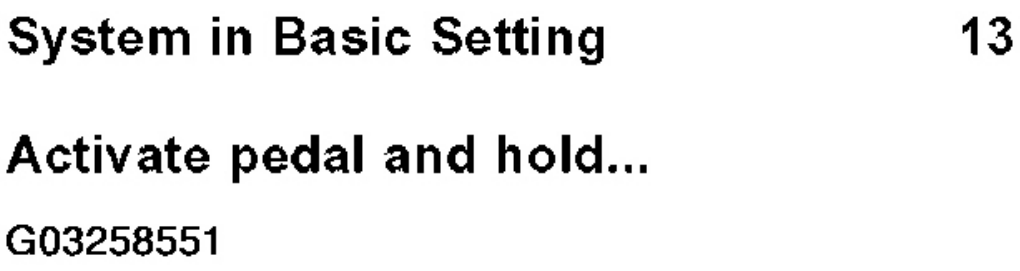

Fig. 76: Bearing Shells - Mounting In Connecting Rods
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Bearing shell -1- for connecting rod (with hole -arrow- for oil channel).

Bearing shell -2- for connecting rod (without hole for oil channel).

- Place bearing shells on the middle of connecting rod and connecting rod bearing cap.

  Measure -a- must be the same at right and left, max. deviation: 0.2 mm

Checking Cylinder Bores

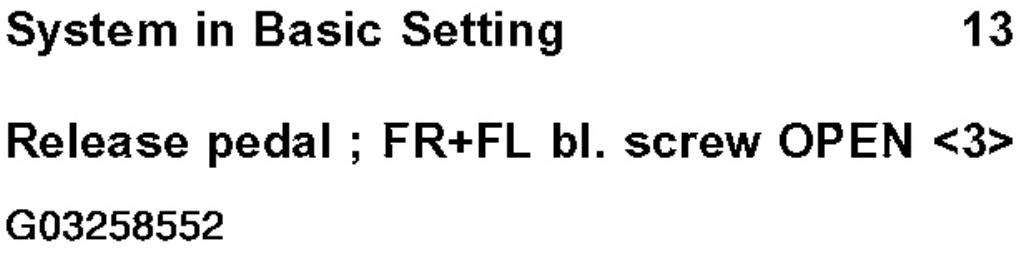

Fig. 77: Checking Cylinder Bores
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Special tools and equipment

- Internal dial gauge 50 to 100 mm

- Measure bores at 3 locations in both directions -A- across the engine and -B- in line with crankshaft.

  Deviation from nominal dimension: max. 0.08 mm

NOTE: Measuring the cylinder bores must not be done when the cylinder block is mounted on a repair stand with adapter bracket VW 540, as incorrect measurements would then be possible.

Piston and cylinder dimensions (engine codes: AWP, AWV)

PISTON AND CYLINDER DIMENSIONS (ENGINE CODES: AWP, AWV)

Honing dimension	Piston diameter	Cylinder bore diameter
Basic dimen. mm	80.965 (1)	81.01
1st oversize mm	81.465 (1)	81.51
(1) Dimension without graphite coating (thickness 0.02 mm). The graphite coating wears away.		

ENGINE - CYLINDER HEAD, VALVETRAIN

CYLINDER HEAD, REMOVING AND INSTALLING

Checking compression. See **COMPRESSION PRESSURES, CHECKING** .

NOTE:

- **When installing an replacement cylinder head with installed camshaft, the contact surfaces between the hydraulic lifters and the cam must be oiled before installing the cylinder head cover.**
- **The plastic packing pieces for protecting the open valves must not be removed until immediately before installing cylinder head.**
- **If the cylinder head is replaced, all the coolant in the system must also be replaced.**
- **Removing and installing intake manifold:**

  For engine code APH, see FUEL INJECTION SYSTEM COMPONENTS, REMOVING AND INSTALLING . For engine codes AWP and AWV, see FUEL INJECTION SYSTEM COMPONENTS, REMOVING AND INSTALLING .

Cylinder head overview

NOTE: The following list refers to items in Fig. 78 .

1. **Cap**
   - Replace seal if damaged
2. **10 N.m**

3. **Cylinder head cover**
4. **Cylinder head cover gasket**
    - Replace if damaged
    - Before installing, coat transition from bearing cap e.g. camshaft adjuster/chain tightener to cylinder head with D 454 300 A2. See **Sealing transition points between double bearing cap and cylinder head** and **Sealing transition points between chain tensioner/cylinder head** .
5. **Oil deflector**
    - Note installation position: above intake camshaft
6. **Cylinder head**
    - Check for distortion. See **Reworking Cylinder Head Sealing Surface**
    - Reworking sealing surface. See **Reworking Cylinder Head Sealing Surface** .
    - Removing and installing. See **CYLINDER HEAD, REMOVING AND INSTALLING** .
    - After replacing completely replace coolant
7. **Intake manifold gasket**
    - Always replace
    - Note installation position
8. **Cylinder head gasket**
    - Always replace
    - Metal gasket
    - If replaced completely replace coolant
    - Note installation position: Identification: Part No. must be readable from intake side
9. **Toothed (Timing) belt**
    - Mark direction of rotation before removing
    - Check for wear
    - Do not kink
    - Removing, installing and tensioning. See **TOOTHED BELT, REMOVING, INSTALLING AND TENSIONING** .
10. **Exhaust manifold gasket**
    - Always replace
    - Note installation position
11. **Cylinder head bolt**
    - Always replace
    - Removing and installing Polydrive cylinder head bolt with 3452
    - Sequence when loosening and tightening. See **CYLINDER HEAD, REMOVING AND INSTALLING** .
12. **Gasket**
    - Replace if damaged

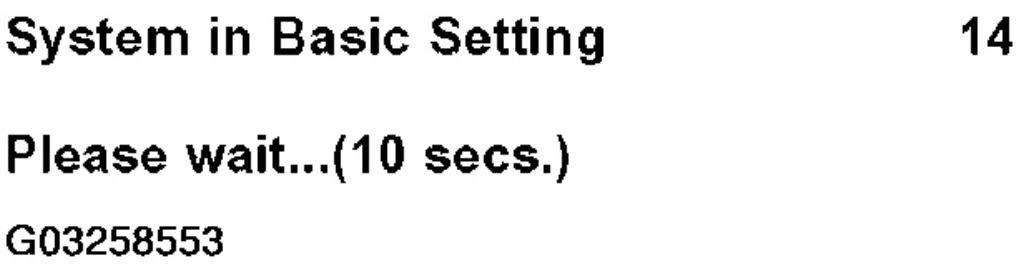

Fig. 78: Exploded View Of Cylinder Head Components
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Checking Cylinder Head For Distortion

Special tools, workshop equipment, testers, measuring instruments and auxiliary items required

- Straight edge
- Feeler gauges

Max. permissible distortion: 0.1 mm

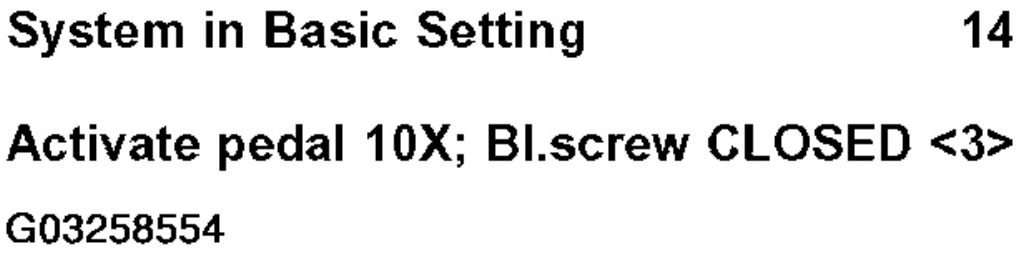

Fig. 79: Checking Cylinder Head For Distortion
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Cylinder head, removing and installing

Special tools and equipment

- VAG 1306 Drip tray

- VAG 1332 Torque wrench (40-200 N.m)
- VAG 1921 Hose clip pliers
- 3070 Installation tool with guide pins
- VAS 5024 Assembly tool for spring-type clamps

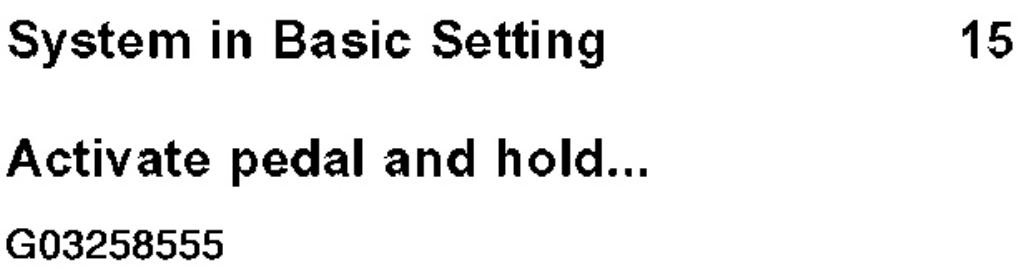

Fig. 80: Identifying Special Tools And Equipment
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Engines with Polydrive cylinder head bolts:

- 3452 Tool

Requirements

- The engine must be no more than warm to touch

Work sequence

- Note safety precautions before starting work. See **SAFETY PRECAUTIONS WHEN WORKING ON FUEL SUPPLY** .
- Observe rules for cleanliness. See **RULES OF CLEANLINESS** .
- Check whether a coded radio is installed. If so, obtain anti-theft coding.
- With ignition switched off, disconnect battery Ground strap.
- Remove engine cover.
- Drain coolant. See **COOLING SYSTEM, DRAINING AND FILLING** .
- Remove secondary air pump motor and bracket.

WARNING: Fuel supply lines are under pressure! Before removing from hose connection wrap a cloth around the connection. Then release pressure by carefully pulling hose off connection.

- Separate fuel supply as well as fuel return pipes at connection on fuel rail. Fuel system is under pressure, therefore place a cloth over connection before hoses are pulled off.
- Seal lines so that fuel system is not contaminated by dirt etc.
- Remove coolant hose connections on cylinder head.
- Remove inter-connecting, coolant, vacuum and intake hoses on engine.
- Pull connector(s) off ignition coils.
- Pull off/disconnect all other electrical connections as necessary from engine and lay to one side.
- Remove intake air hose from connection of exhaust turbocharger as follows:
- Pull off hose at pressure regulator valve of crankshaft ventilation.
- Disconnect harness connector at Wastegate Bypass Regulator Valve -N75-.
- Pull off hose at Wastegate Bypass Regulator Valve -N75-.
- Disconnect hose from solenoid valve to turbocharger at bulkhead.
- Disconnect hose between EVAP canister and exhaust turbocharger at bulkhead.
- Pull out securing buckle at connector of exhaust turbocharger and remove air intake hose.
- Remove heat protection pad 1 from air guiding hose 2 (observe installation position).

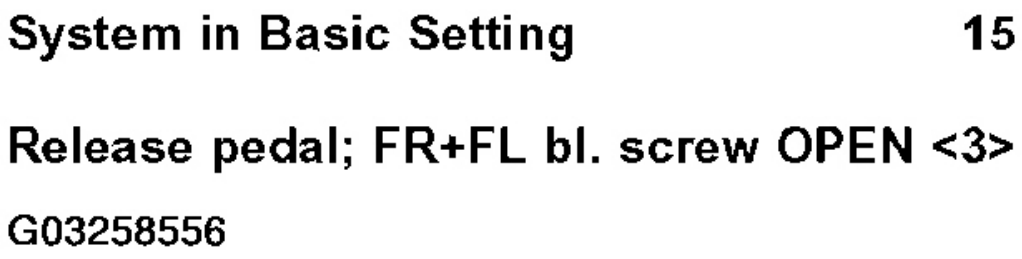

Fig. 81: Removing Heat Protection Pad 1 From Air Guiding Hose 2
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove air guiding hose 2.
- Loosen 2 bolts from bracket of upper air guiding hose. See **ONLY FOR ENGINE CODE APH** , Item 8
- Remove heat protection pad from air guiding hose (observe installation position) and loosen clamp 3.

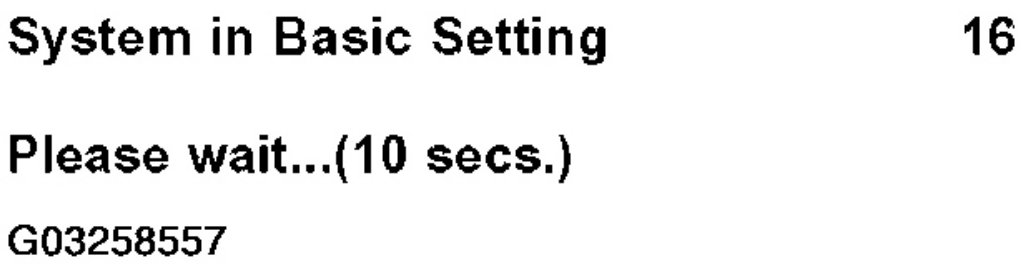

Fig. 82: Removing Heat Protection Pad From Air Guiding Hose And Loosening Clamp 3
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove screws 1 and 4 for heat shield from behind cylinder head.
- Loosen screws 2 and 5.
- Remove air guiding hose, hose to turbocharger and heatshield.
- Remove three exhaust gas turbocharger/exhaust manifold securing bolts -arrows-.

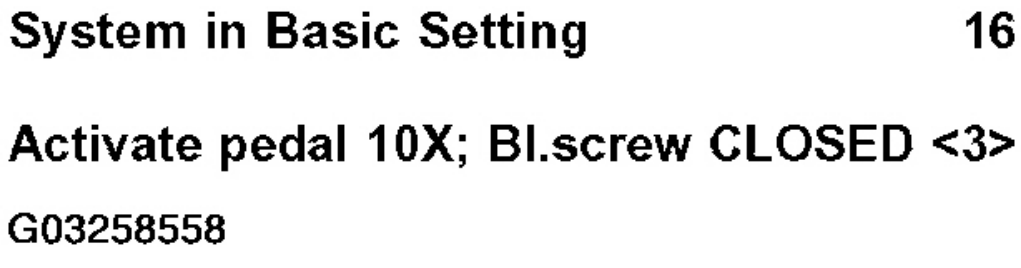

Fig. 83: Removing Three Exhaust Gas Turbocharger/Exhaust Manifold Securing Bolts
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove ribbed belt. See **RIBBED BELT TENSIONER, REMOVING AND INSTALLING** .
- Remove tensioning element for ribbed belt.
- Remove toothed belt guard (upper part).
- Set camshaft sprocket to TDC No. 1 cylinder by turning crankshaft. Mark on camshaft sprocket must align with arrow on toothed belt guard.

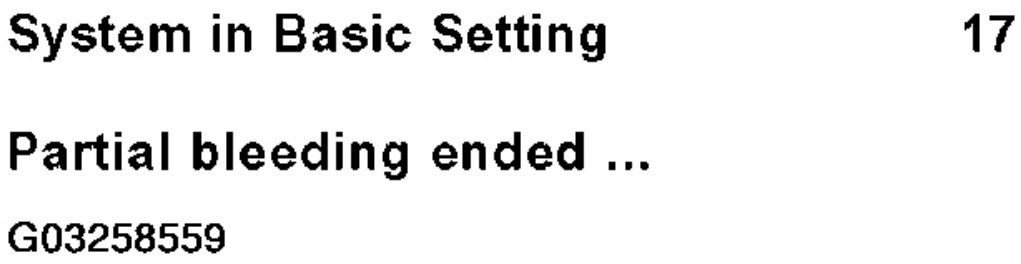

Fig. 84: Aligning Mark On Camshaft Sprocket With Arrow On Toothed Belt Guard
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Mark direction of rotation of toothed belt.
- Remove toothed belt and toothed belt tensioner. See **TOOTHED BELT, REMOVING, INSTALLING AND TENSIONING** .
- Turn crankshaft back slightly.
- Loosen pressure piston again and remove threaded pin.
- Remove ignition coils.
- Remove cylinder head cover.
- Loosen socket head bolts in sequence given and then remove completely.

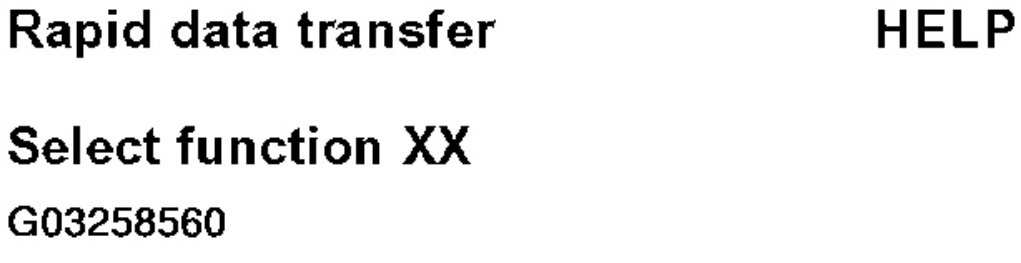

Fig. 85: Loosening Socket Head Bolts In Sequence
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: Use tool 3452 for Polydrive cylinder head bolts.

- Carefully lift cylinder head off.

Installing

NOTE:

- **There must be no oil or coolant in the cylinder head bolt pockets in the cylinder head.**
- **Only remove the new cylinder head gasket from its packing immediately before installing.**
- **Handle the new gasket with extreme care. Damaging will lead to leaks.**

- Place a clean cloth in cylinders so that no dirt or emery cloth particles can get in between cylinder wall and piston. Also prevent dirt and emery cloth particles from getting into coolant
- Carefully clean cylinder head and cylinder block sealing surfaces. Ensure that no scoring or scratches are formed (when using abrasive paper the grade must not be less than 100).
- Carefully remove metal particles, emery remains and cloths.
- Turn crankshaft to TDC No. 1 cylinder.

Fig. 86: Turning Crankshaft To TDC Of No. 1 Cylinder
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Turn crankshaft back slightly.
- Loosen bolts 1 and 2 at bracket for turbocharger approx. 2 revolutions in order to avoid tension when installing cylinder head.

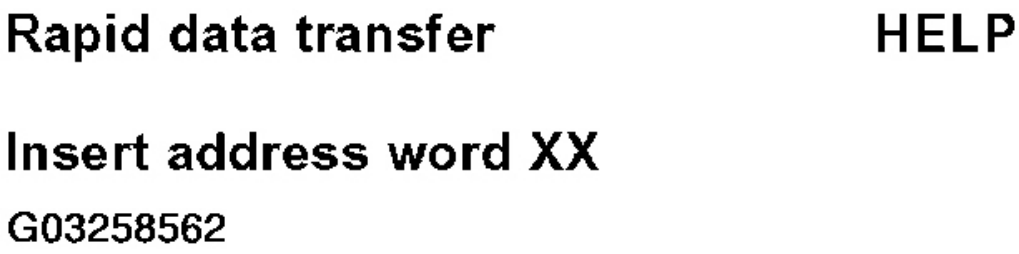

Fig. 87: Loosening Bolts 1 And 2 At Bracket For Turbocharger
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Center screw guide pins from 3070 into holes for cylinder head bolts 8 and 10.

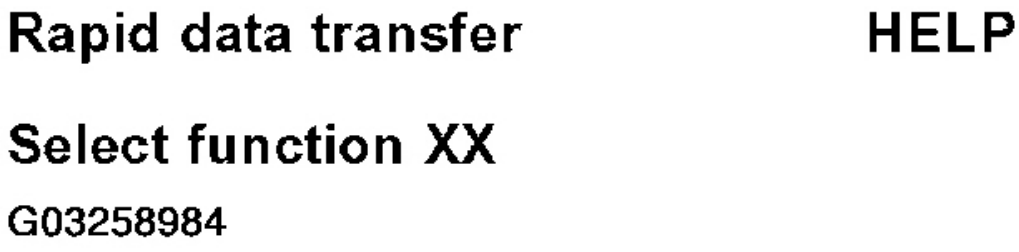

Fig. 88: Installing Cylinder Head Bolts
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Install new cylinder head gasket. Lettering (Part No.) must be readable.
- Install cylinder head, screw in 8 remaining cylinder head bolts and tighten by hand.
- Remove guide pins with removal tool from 3070. To do this turn removal tool counterclockwise, until pins are free.
- Install remaining cylinder head bolts and tighten hand-tight.
- Tighten cylinder head in tightening sequence as follows:

Rapid data transfer Q

03-Final control diagnosis

G03258985

Fig. 89: Cylinder Head Bolt Tightening Sequence
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Pretighten all bolts to 40 N.m.
- Then tighten all bolts 1/4 turn (90°) further using a rigid wrench.
- Then tighten all bolts again 1/4 turn (90°) further.

NOTE: There is no requirement to retighten the cylinder head bolts after repairs.

- Install gasket between turbocharger/exhaust manifold and bolt turbocharger as well as bracket to cylinder head.
- Install toothed belt and adjust valve timing. See **TOOTHED BELT, REMOVING, INSTALLING AND TENSIONING** .

Filling with new coolant. See **COOLING SYSTEM, DRAINING AND FILLING** .

The rest of the assembly is basically a reverse of the disassembling sequence.

- Perform work sequence "Procedure after voltage supply open circuit".

  For engine code APH see **PROCEDURE AFTER CORRECTING VOLTAGE SUPPLY OPEN CIRCUIT** . For engine codes AWP and AWV, see **PROCEDURE AFTER CORRECTING VOLTAGE SUPPLY OPEN CIRCUIT** .

- Check DTC memory.

  See **GENERAL INFORMATION FOR ON BOARD DIAGNOSTIC (OBD)** .

- Read readiness code.

  See **READINESS CODE** .

- Match engine electronics control module to throttle valve control module.

  For engine code APH, see **ENGINE CONTROL MODULE (ECM) TO THROTTLE VALVE CONTROL MODULE, ADAPTING** . For engine codes AWP and AWV, see **MOTRONIC ENGINE CONTROL MODULE (ECM) - J220- TO THROTTLE VALVE CONTROL MODULE - J338-, ADAPTING** .

  If the DTC memory has been erased or the Engine Control Module separated from permanent (battery) positive, the readiness code must be generated again.

  See **GENERAL INFORMATION FOR ON BOARD DIAGNOSTIC (OBD)** .

Compression pressures, checking

Special tools and equipment

- 3122 B Spark plug removal tool
- VAG 1331 Torque wrench (5-50 N.m)
- VAG 1763 Compression tester

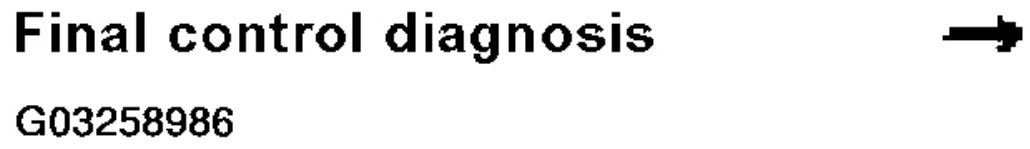

Fig. 90: Identifying Special Tools And Equipment
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Requirements

- Remove fuse 32.

  NOTE: Removing fuse 32 interrupts the voltage supply to the injectors. Fuse block is behind access panel at far left end of dash.

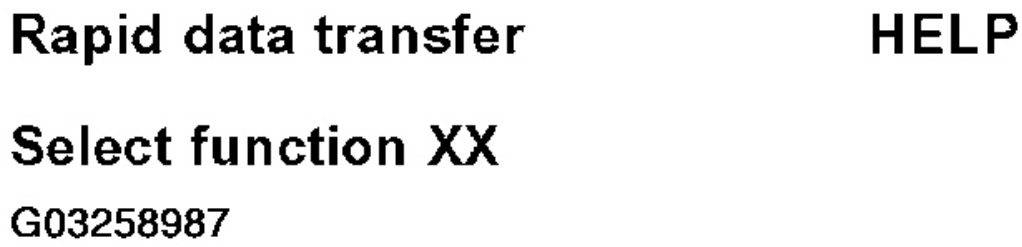

Fig. 91: Removing Fuse 32
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Test conditions

- Engine oil temperature must be at least 30 °C.

Work sequence

- Remove engine cover.
- Pull connector(s) off ignition coils.
- Remove ignition coils.
- Remove spark plugs with spark plug removal tool 3122B.
- Fully open throttle valve.

NOTE: Using the compression tester. See Operating instructions.

- Check compressions with compression tester VAG 1381 / VAG 1763.
- Operate starter until tester shows no further pressure increase.

Compression pressure:

- New: 10-14 bar
- Wear limit: 7.0 bar
- Permissible difference between all cylinders: 3 bar
    - Thread in spark plugs with spark plug socket and extension 3122B and tighten to 30 N.m.

Vehicles with engine code: APH

- Install ignition coils and tighten to 10 N.m.

Vehicles with engine codes: AWP, AWV

- Install ignition coils. During this, make sure ignition coils are securely seated.

Continued for all vehicles

- Check DTC memory.

  See **GENERAL INFORMATION FOR ON BOARD DIAGNOSTIC (OBD)** .

- Read readiness code.

  See **READINESS CODE** .

  If the DTC memory has been erased or the Engine Control Module separated from permanent (battery) positive, the readiness code must be generated again.

  See **GENERAL INFORMATION FOR ON BOARD DIAGNOSTIC (OBD)** .

VALVE GEAR, SERVICING

NOTE:

- **Cylinder heads which have cracks between the valve seats or between valve seat inserts and the spark plug thread can be used further without reducing service life, provided the cracks do not exceed a maximum of 0.3 mm in width, or when no more than the first four spark plug threads are cracked.**
- **After installing new hydraulic lifters, the engine must not be started for approx. 30 minutes (otherwise valves will strike pistons), then turn crankshaft two rotations.**

NOTE: The following list refers to items in Fig. 92 .

1. **10 N.m**
2. **Intake camshaft**
   - Checking axial clearance. See **Checking Camshaft Axial Clearance**
   - Removing and installing. See **VALVE GEAR, SERVICING**

     Checking radial clearance with plastigage:

   - Wear limit: 0.1 mm
   - Run-out: max. 0.01 mm
3. **Drive chain**
   - Before removing mark direction of rotation (installation position). See **CAMSHAFT, REMOVING AND INSTALLING** .

4. **10 N.m**
5. **O-ring**
    - Always replace
    - Only for engine codes: AWP, AWV
6. **Camshaft adjustment valve (N205)**
    - Only for engine codes: AWP, AWV
    - Check camshaft adjustment. See **CAMSHAFT ADJUSTMENT, CHECKING** .
7. **3 N.m**
    - Only for engine codes: AWP, AWV
8. **Camshaft adjuster**
    - Only for engine codes: AWP, AWV
    - For vehicles with engine code: APH; Chain tensioner
    - Secure with 3366 before removing. See **CAMSHAFT, REMOVING AND INSTALLING** .
        - Seal transition of hydraulic chain tensioner/cylinder head. See **Sealing transition points between chain tensioner/cylinder head**
    - Check camshaft adjustment. See **CAMSHAFT ADJUSTMENT, CHECKING** .
9. **Gasket**
    - Rubber/metal seal
    - Replace
10. **Cylinder head**
    - Removing and installing. See **CYLINDER HEAD, REMOVING AND INSTALLING** .
    - Refacing valve seats. See **VALVE SEATS, REFACING** .
    - Reworking sealing surface. See **Reworking Cylinder Head Sealing Surface** .
    - Sealing transition points. See **Sealing transition points between double bearing cap and cylinder head** and **Sealing transition points between chain tensioner/cylinder head** .
11. **Valves**
    - Do not rework only grinding-in is permitted
    - Valve dimensions. See **Valve Dimensions** .
    - Sodium-filled exhaust valves: Observe disposal instructions. See **VALVE SEATS, REFACING**
12. **Oil seal**
    - Replacing. See **CAMSHAFT OIL SEAL, REPLACING** .
13. **Hood**
    - For Camshaft Position (CMP) sensor
    - When installing note fixing arrangement
14. **Washer**
    - Conical
15. **25 N.m**
16. **Camshaft Position (CMP) sensor -G40-**

See **CHECK CAMSHAFT POSITION (CMP) SENSOR** .

17. **10 N.m**
18. **65 N.m**
    - Use counter-hold 3036 to loosen and tighten
19. **Camshaft sprocket**
    - Note installation position: small web of camshaft sprocket points outward and No. 1 Cyl. TDC marking is visible
    - Note position when installing toothed belt. See **TOOTHED BELT, REMOVING, INSTALLING AND TENSIONING** .
20. **Oil seal**
    - Replacing. See **CAMSHAFT OIL SEAL, REPLACING** .
21. **Valve guide**
    - Checking. See **VALVE GUIDES, CHECKING** .
22. **Valve stem seal**
    - Replacing. See **VALVE STEM SEALS, REPLACING** .
23. **Valve spring**
    - Removing and installing: remove cylinder head with 3362
    - Installing. See **VALVE STEM SEALS, REPLACING** .
24. **Upper valve spring plate**
25. **Valve keepers**
26. **Hydraulic lifter**
    - Do not interchange
    - With hydraulic valve clearance compensation
    - Checking. See **HYDRAULIC LIFTERS, CHECKING**
    - Store with cam contact surface downward
    - Before installing check camshaft axial clearance. See **Checking Camshaft Axial Clearance** .
    - Oil contact surface
27. **Intake camshaft bearing cap**
    - Installation position and installation sequence. See **CAMSHAFT, REMOVING AND INSTALLING** .
28. **Double bearing cap**
    - Lightly coat bearing cap contact surface with sealant AMV 174 004 01
    - Must sit on alignment bushing
    - Seal transitions of double-bearing cap/cylinder head. See **Sealing transition points between double bearing cap and cylinder head** .
29. **Exhaust camshaft bearing cap**
    - Installation position and installation sequence. See **CAMSHAFT, REMOVING AND INSTALLING** .

30. **Exhaust camshaft**
    - Checking axial clearance. See **Checking Camshaft Axial Clearance**
    - Removing and installing. See **CAMSHAFT, REMOVING AND INSTALLING** .

    Checking radial clearance with plastigage:

    - Wear limit: 0.1 mm
    - Run-out: max.: 0.01 mm

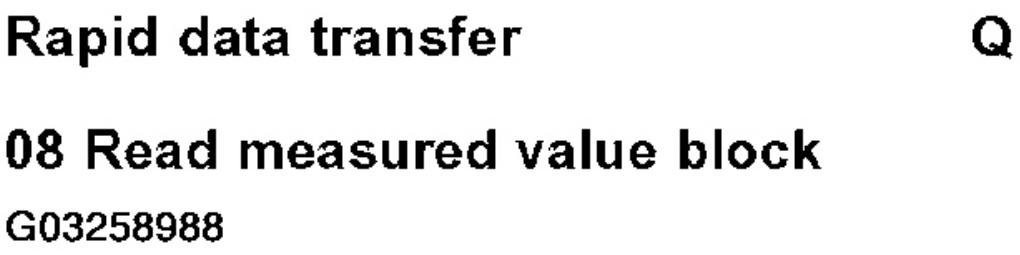

Fig. 92: Exploded View Of Valve Train Components
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Reworking Cylinder Head Sealing Surface

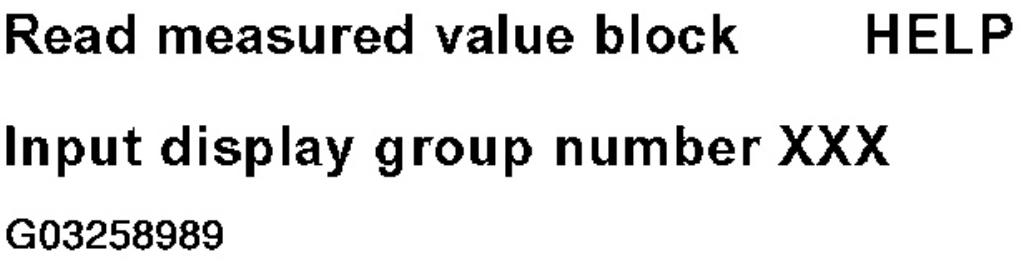

Fig. 93: Measuring Point For Reworking Cylinder Head Sealing Surface
Courtesy of VOLKSWAGEN OF AMERICA, INC.

The dimension for reworking is measured through the holes for the cylinder head bolts.

-a- = minimum 139.2 mm

Checking Camshaft Axial Clearance

Special tools and equipment

- Universal dial indicator bracket VW 387
- Dial indicator

Check with hydraulic lifters and chain removed and No. 2 and 4 bearing caps installed.

Wear limit: max. 0.2 mm

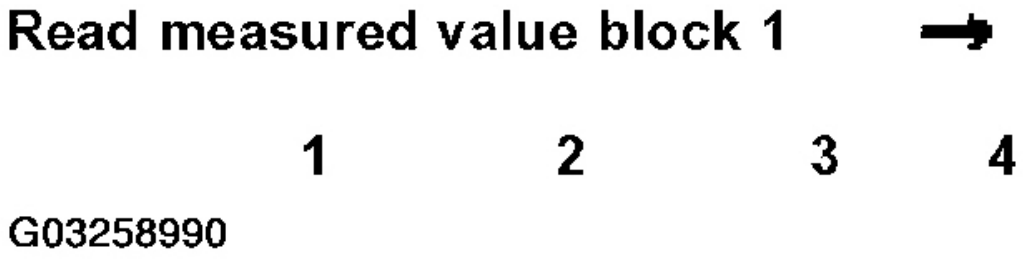

Fig. 94: Checking Camshaft Axial Clearance
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Valve Dimensions

NOTE: Valves must not be reworked. Only lapping-in is permitted.

NOTE: The following table refers to items in Fig. 95 .

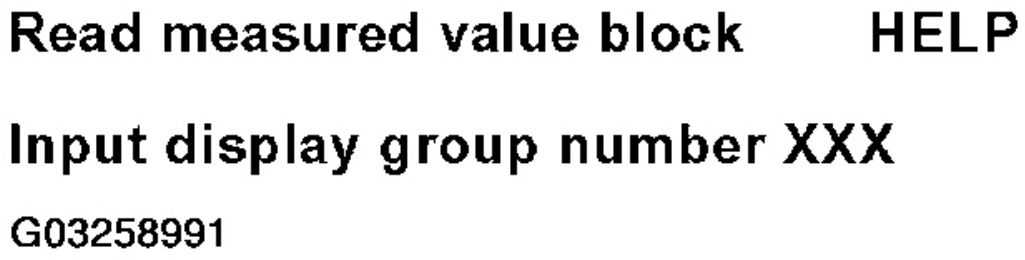

Fig. 95: Valve Dimensions
Courtesy of VOLKSWAGEN OF AMERICA, INC.

VALVE DIMENSIONS

Dimension	Intake valve	Exhaust valve
dia. a (mm)	26.9	29.9
dia. b (mm)	5.963	5.943
c (mm)	104.84 - 105.34	103.64 - 104.14
Angle a (angle °)	45	45

NOTE: Care must be taken when disposing of old sodium filled valves. They must be cut through in the center of the stem with a hacksaw. When doing this they must be perfectly dry. The valves prepared in this way can then be thrown into a bucket of water a maximum of ten at a time. When doing this step back quickly because a sudden chemical reaction causes the sodium filling to burn. After this treatment, the valves can be put in with the normal scrap.

Sealing transition points between double bearing cap and cylinder head

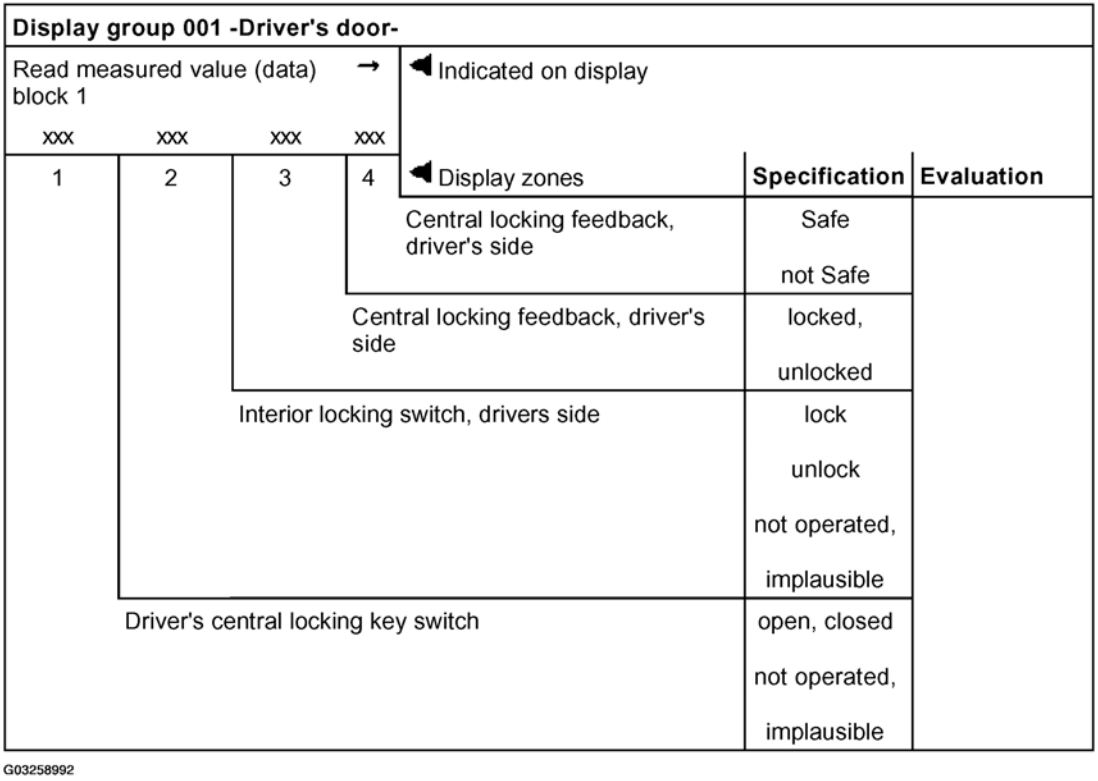

Fig. 96: Identifying Sealing Transition Points Between Double Bearing Cap And Cylinder Head
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Carefully apply a thin coat of sealant D 454 300 A2 to both edges of sealing surfaces between double bearing cap and cylinder head -arrows- using a small screwdriver.

Sealing transition points between chain tensioner/cylinder head

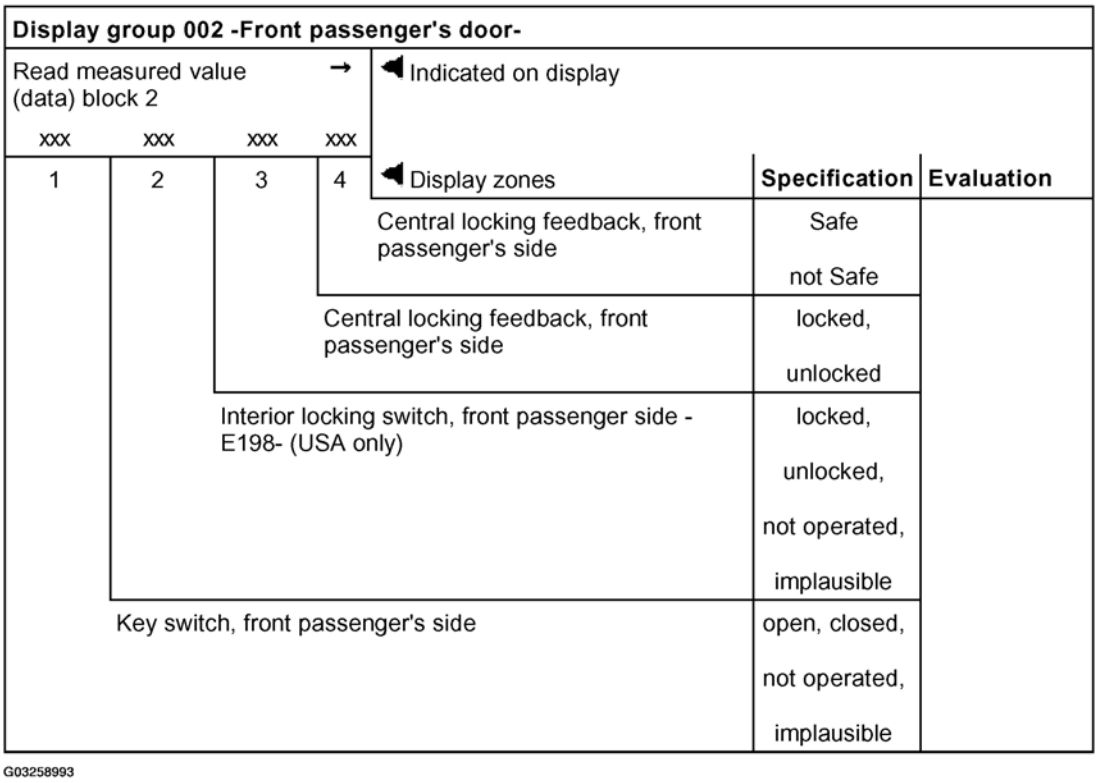

Fig. 97: Identifying Sealing Transition Points Between Chain Tensioner/Cylinder Head
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Carefully apply a thin coat of sealant "D 454 300 A2" to both edges of sealing surfaces between camshaft adjuster and cylinder head -arrows- using a small screwdriver.

Valve seats, refacing

Special tools and equipment

- Depth gauge
- Valve seat refacing tool

NOTE:

- **When repairing engines with leaking valves, it is not sufficient to replace or replace valve seats and valves. It is also necessary to check the valve guides for wear. This particularly important on high mileage engines. See VALVE GUIDES, CHECKING .**
- **The valve seats should only be reworked just enough to produce a perfect seating pattern. The maximum permissible reworking dimension must be calculated before reworking commences. If the reworking dimension is exceeded, the function of the hydraulic lifters can no longer be guaranteed and the cylinder head should be replaced.**

The max. permissible reworking dimension is calculated as follows:

- Insert valve and press firmly against seat.

  NOTE: If the valve is to be replaced as part of a repair, use a new valve for the calculation.

- Measure distance between end of valve stem and upper edge of cylinder head.

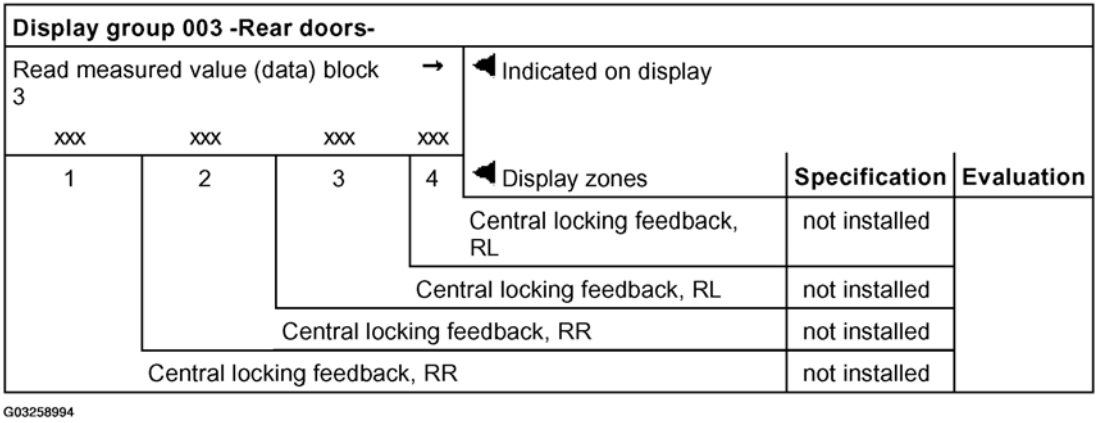

Fig. 98: Measuring Distance Between End Of Valve Stem And Upper Edge Of Cylinder Head
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Calculate max. permissible reworking dimension from measured distance and minimum dimension.

  Minimum dimension:

  Outer intake valves: 34.0 mm

  Center intake valve: 33.7 mm

Exhaust valve: 34.4 mm

Measured distance minus minimum dimension = max. permissible reworking dimension.

Example:

CALCULATING PERMISSIBLE REWORKING DIMENSION

Measured distance	34.4 mm
- Minimum dimension	34.0 mm
= max. perm. rework dimension (1)	0.4 mm
(1) The max. permissible reworking dimension is shown on illustrations for refacing valve seats as	

dimension "b."

Reworking intake valve seat

Display group 004 -Central control unit-						
Read measured value (data) block 4 →				◀ Indicated on display		
xxx	xxx	xxx				
1	2	3	4	◀ Display zones	Specification	Evaluation
				Empty[1)]		
				Rotary latch switch, rear	not installed	
				Rotary latch switch, front passenger's side	door open, door closed	
				Rotary latch switch, driver's side	door open, door closed	

[1)] Empty means in this case: Display zone is blank

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Fig. 99: Reworking Valve Seat Dimensions
Courtesy of VOLKSWAGEN OF AMERICA, INC.

a = 26.2 mm diameter

b = Max. permissible reworking dimension

NOTE: Calculating max. permissible reworking dimension. See VALVE SEATS, REFACING .

c = 1.5- 1.8 mm

Z = Cylinder head lower edge

"ALPHA" = 45° valve seat angle

"BETA" = 30° upper correction angle

"GAMMA" = 60° lower correction angle

Reworking exhaust valve seat

a = 29.0 mm diameter

b = Max. permissible reworking dimension

NOTE: Calculating max. permissible reworking dimension. See VALVE SEATS, REFACING .

c = Approx. 1.8 mm

Z = Cylinder head lower edge

"ALPHA" = 45° valve seat angle

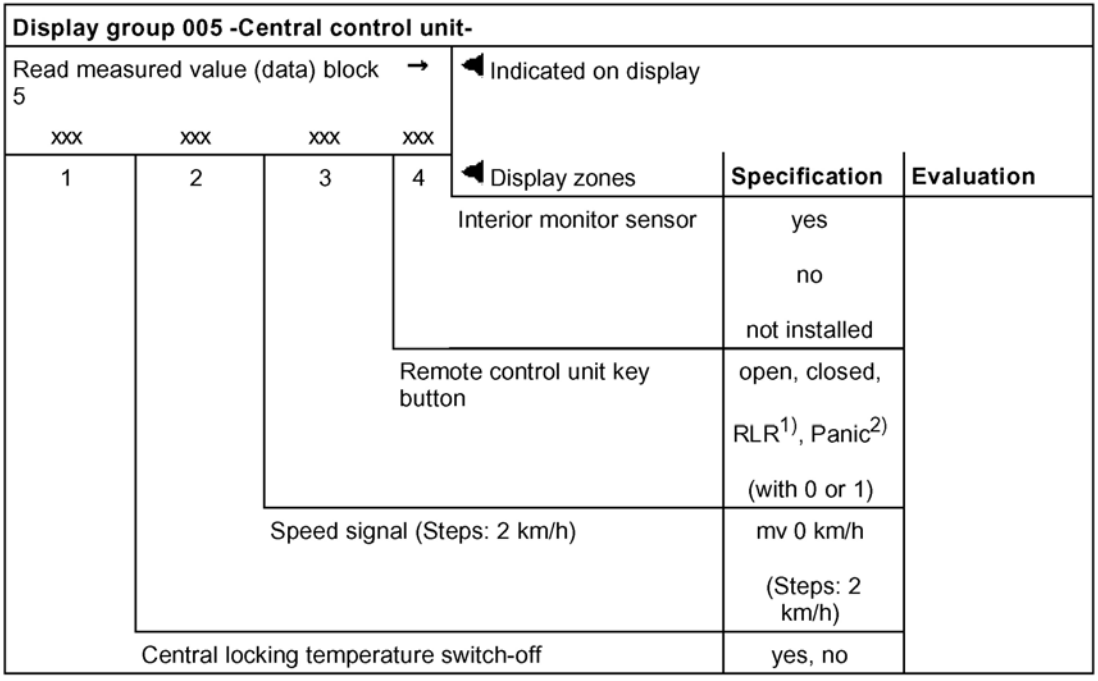
"BETA" = 30° upper correction angle

"GAMMA" = 60° lower correction angle

Camshaft oil seal, replacing

Special tools and equipment

- VAG1331 Torque wrench (5-50 N.m)
- VAG1332 Torque wrench (40-200 N.m)
- 3036 Counter hold tool
- 3241 Fitting sleeves
- 2085 Oil seal extractor



Display group 005 -Central control unit-						
Read measured value (data) block → 5				◀ Indicated on display		
xxx	xxx	xxx	xxx			
1	2	3	4	◀ Display zones	**Specification**	**Evaluation**
				Interior monitor sensor	yes no not installed	
				Remote control unit key button	open, closed, RLR[1], Panic[2] (with 0 or 1)	
				Speed signal (Steps: 2 km/h)	mv 0 km/h (Steps: 2 km/h)	
				Central locking temperature switch-off	yes, no	

[1] Only vehicles for USA, RLR= Rear lid Remote release

[2] Only vehicles for USA, alarm system and turn signal lights are activated

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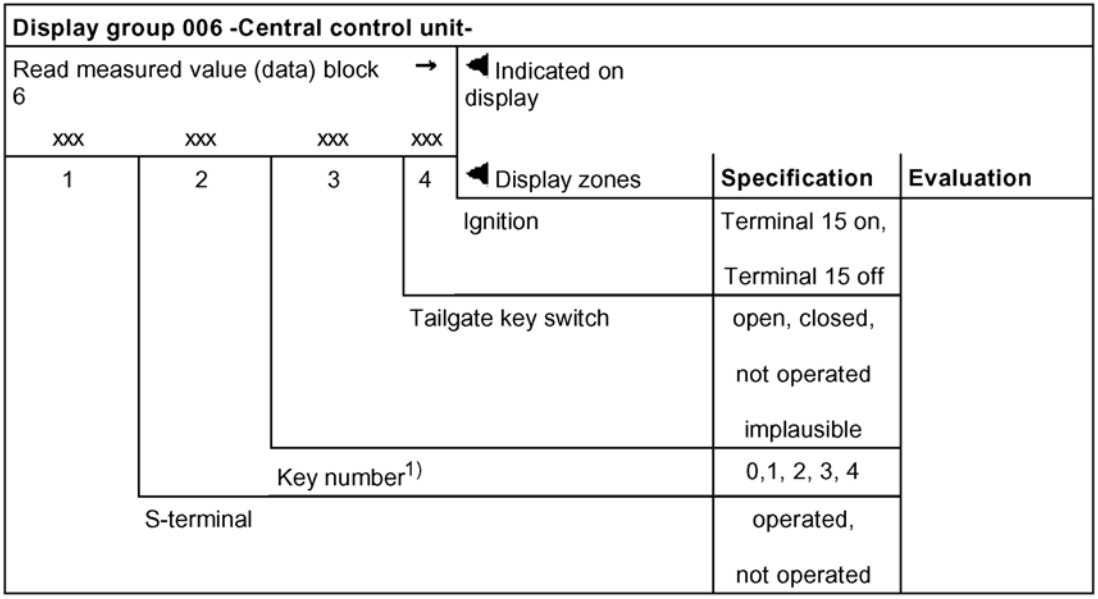
Fig. 100: Identifying Special Tools And Equipment
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Removing oil seal on camshaft sprocket

- Remove seal on Camshaft Position (CMP) sensor. See **OIL SEAL ON CAMSHAFT POSITION (CMP) SENSOR, REMOVING** .
- Remove toothed belt guard (upper part).
- Set camshaft sprocket to TDC No. 1 cylinder by turning crankshaft. Mark on camshaft sprocket must align with mark on cylinder head cover.



Display group 006 -Central control unit-						
Read measured value (data) block 6 →				◀ Indicated on display		
xxx	xxx	xxx	xxx			
1	2	3	4	◀ Display zones	**Specification**	**Evaluation**
				Ignition	Terminal 15 on, Terminal 15 off	
				Tailgate key switch	open, closed, not operated implausible	
				Key number[1)]	0,1, 2, 3, 4	
				S-terminal	operated, not operated	

[1)] Display 1 for remote control key 1 is performed by operating a button on remote control key

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Fig. 101: Aligning Mark On Camshaft Sprocket With Mark On Cylinder Head Cover
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove cylinder head cover.
- Release tensioner and remove toothed belt from camshaft sprocket.
- Turn crankshaft back slightly.
- Remove camshaft sprocket. When loosening camshaft sprocket bolt counter-hold with 3036.
- Remove woodruff key from camshaft.
- Screw camshaft sprocket securing bolt -arrow- into camshaft onto stop by hand, to guide seal extractor.

Display group 007 -Central control unit-						
Read measured value (data) block 7 →				◀ Indicated on display		
xxx	xxx	xxx	xxx			
1	2	3	4	◀ Display zones	**Specification**	**Evaluation**
				Sliding/tilting sunroof (STR) control	open, closed, not operated	
				Sliding/tilting sunroof (STR) authorized 1)	yes, no	
				Trunk lid/tailgate contact switch	open, closed	
				Hood contact switch	open, closed, not installed	

1) The control unit sends a "switch-off delay" terminal 15 to sliding/tilting sunroof. Therefore the operation of the sliding/tilting sunroof is still possible, after switching off the ignition, and until a door is opened.

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Fig. 102: Screwing Camshaft Sprocket Securing Bolt Into Camshaft Onto Stop
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Unscrew inner part of oil seal extractor 2085 two turns (approx. 3 mm) out of outer part and lock in position with knurled screw.
- Lubricate threaded head of oil seal extractor, place it in position and exerting firm pressure screw it into oil seal as far as possible.
- Loosen knurled screw and turn inner part of extractor against camshaft until oil seal has been extracted.

Display group 008 -Central control unit-						
Read measured value (data) block 8 →				Indicated on display		
xxx	xxx	xxx	xxx			
1	2	3	4	Display zones	Specification	Evaluation
				Empty[1]		
				Interior monitoring switch-off[3]	on, off, not installed	
				Rear lid button and rear lid handle[2]	Not operated, RLR and RL handle, implausible	
				Vehicle system voltage terminal 30	Volts	

[1] Empty means in this case: Display zone is blank

[2] Rear lid remote unlocking button, rear lid handle

[3] Interior monitoring switch-off

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Fig. 103: Removing Oil Seal Using Special Tool 2085
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Installing

NOTE: Gradual introduction of PTFE (Teflon) oil seal (identifying characteristics: no annular spring, sealing lip wider). The sealing lip of this oil ring must not be oiled or lubricated. A plain encased seal of older construction (with annular spring) may be replaced with a PTFE oil seal, but not vice versa.

- Before installing, remove oil remains from crankshaft journal with a clean cloth.
- Install guide sleeve 3241/2 onto camshaft journal.

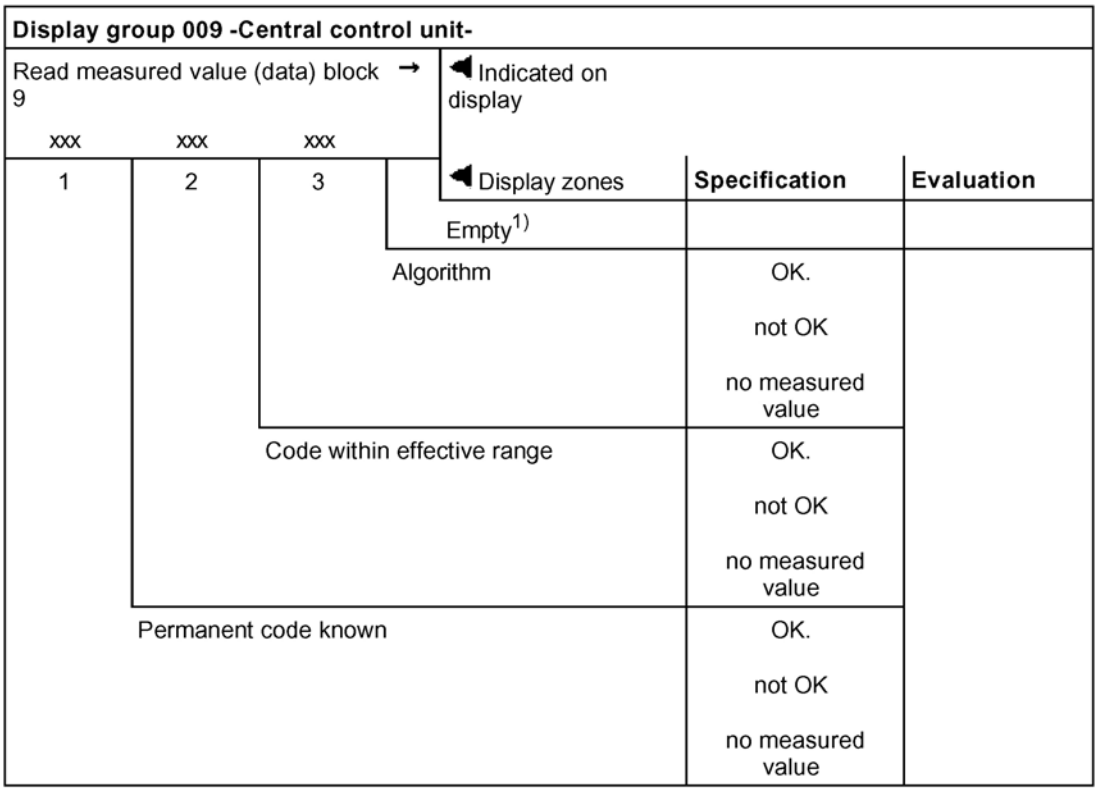

Fig. 104: Installing Guide Sleeve 3241/2 Onto Camshaft Journal
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Slide oil seal over guide sleeve.
- Press seal in onto stop with press sleeve 3241/1 and bolt 3241/5.

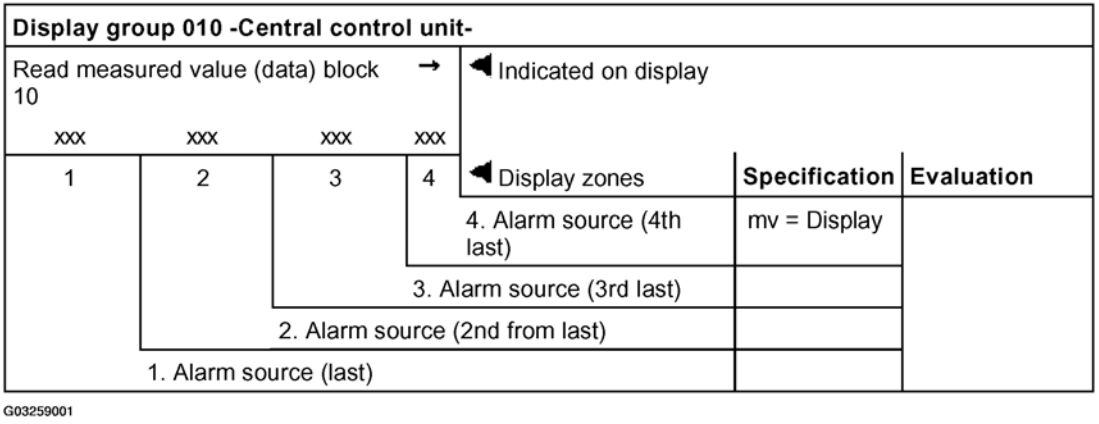

Fig. 105: Pressing Seal In Onto Stop With Press Sleeve 3241/1 And Bolt 3241/5

Courtesy of VOLKSWAGEN OF AMERICA, INC.

The rest of the assembly is basically a reverse of the disassembling sequence.

Installing toothed belt and adjusting timing. See **TOOTHED BELT, REMOVING, INSTALLING AND TENSIONING** .

Oil seal on Camshaft Position (CMP) sensor, removing

Special tools and equipment

- 2085 Oil seal extractor
- 3241 Seal installer (for seal in standard version with annular spring)
- T10071 Puller (for seal in PTFE-version)
- VAG1331 Torque wrench (5 to 50 N.m)
- VAG1332 Torque wrench (40 to 200 N.m)
- Bolt M8 X 60

Display group 011 -Central control unit-

Read measured value (data) block 11 →				◀ Indicated on display		
xxx	xxx	xxx	xxx			
1	2	3	4	◀ Display zones	**Specification**	**Evaluation**
				Empty[1)]		
				Rear lid prelock catch[2)]	open, closed, not installed	
				Automatic- lock / unlock- switch	Not relevant	
				Immobilizer key recognition	yes, no, not installed	

1) Empty means in this case: Display zone is blank

2) Rotary latch of lock must be detent in the first stage

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Fig. 106: Identifying Special Tools And Equipment
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Removing

- Pull connector off Camshaft Position (CMP) sensor -G40- -arrow-.

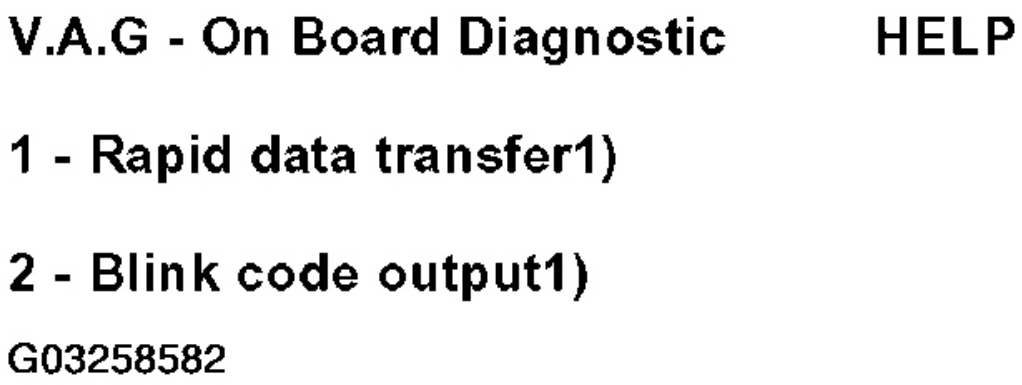

Fig. 107: Pulling Connector Off Camshaft Position Sensor G40
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove toothed belt guard (upper part).
- Remove housing for Camshaft Position (CMP) sensor.
- Remove washer and hood for Camshaft Position (CMP) sensor.
- Screw bolt 2085/1 into camshaft onto stop by hand, to guide seal extractor.

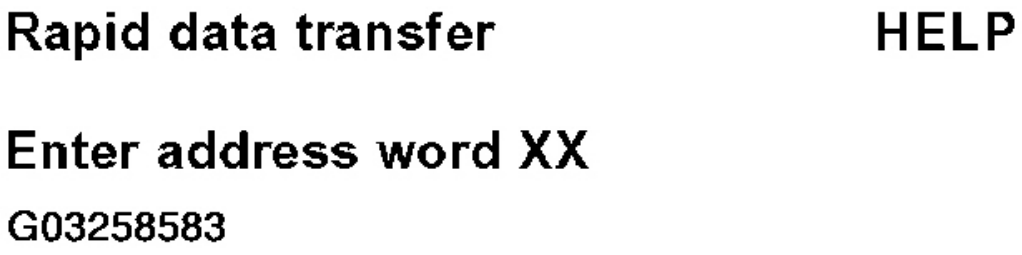

Fig. 108: Screwing Bolt 2085/1 Into Camshaft Onto Stop By Hand To Guiding Seal Extractor
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Unscrew inner part of oil seal extractor 2085 two turns (approx. 3 mm) out of outer part and lock in position with knurled screw.

- Lubricate threaded head of oil seal extractor, place it in position and exerting firm pressure screw it into oil seal as far as possible.

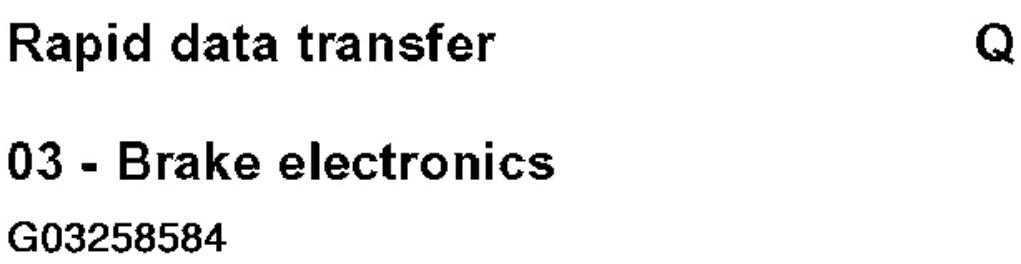

Fig. 109: Lubricating Threaded Head Of Oil Seal Extractor And Placing In Position
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Loosen knurled screw and turn inner part of extractor against camshaft until oil seal has been extracted.

Installing

NOTE: Gradual introduction of PTFE (Teflon) oil seal (identifying characteristics: no annular spring, sealing lip wider). The sealing lip of this oil ring must not be oiled or lubricated. A plain encased seal of older construction (with annular spring) may be replaced with a PTFE oil seal, but not vice versa.

Installing PTFE seal

- Remove oil remains from crankshaft journal with a clean cloth.
- Install guide sleeve T10071/5 onto camshaft journal.

Fig. 110: Installing Guide Sleeve T10071/5 Onto Camshaft Journal
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Slide oil seal over guide sleeve.
- Press seal in onto limit stop using press sleeve T10071/3 and bolt M8 x 60 -1-.

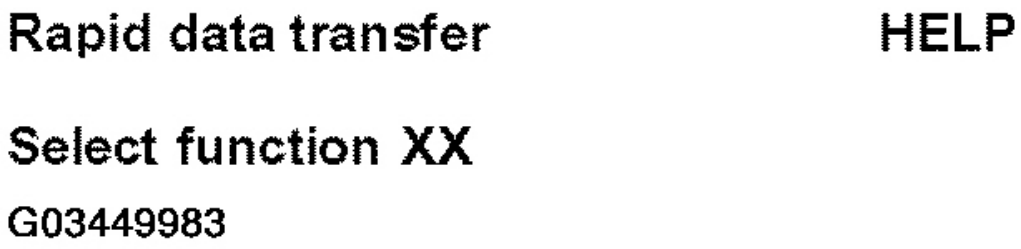

Fig. 111: Pressing Seal In Onto Limit Stop Using Press Sleeve T10071/3 And Bolt M8 X 60
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Installing seal with annular spring

- Lightly oil sealing lip of oil seal.
- Install guide sleeve 3241/2 onto camshaft journal.

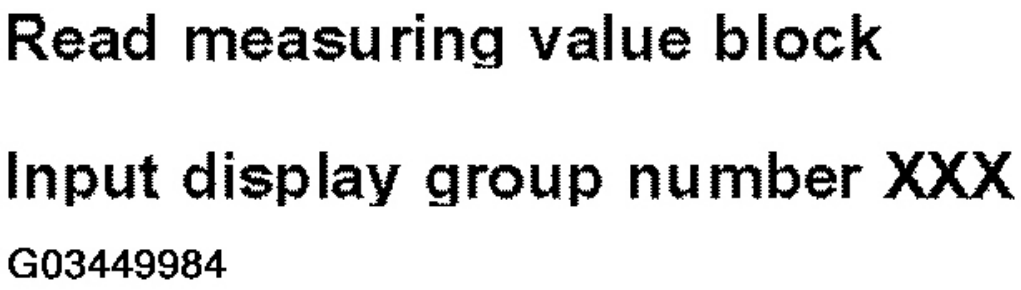

Fig. 112: Installing Guide Sleeve 3241/2 Onto Camshaft Journal
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Slide oil seal over guide sleeve.
- Press seal in onto stop with press sleeve 3241/1 and bolt 3241/3.

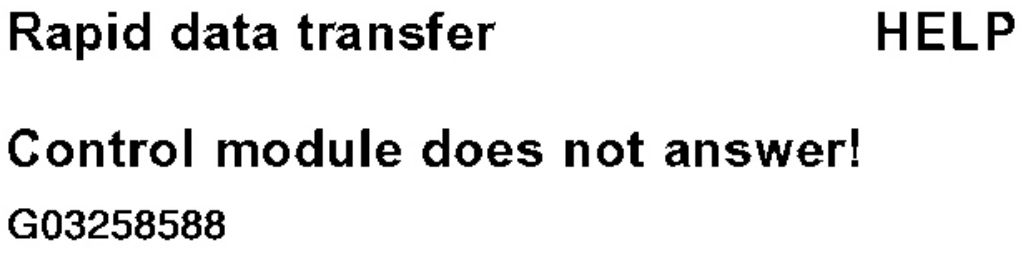

Fig. 113: Pressing Seal In Onto Stop With Press Sleeve 3241/1 And Bolt 3241/3
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Continued for all seals

- Insert Camshaft Position (CMP) sensor hood into notch in inlet camshaft.
- Install washer (taper facing outward) and tighten securing bolt to 25 N.m.
- Install housing for Camshaft Position (CMP) sensor and tighten to 10 N.m.
- Install upper toothed belt guard.
- Reconnect connector on Camshaft Position (CMP) sensor -arrow-.

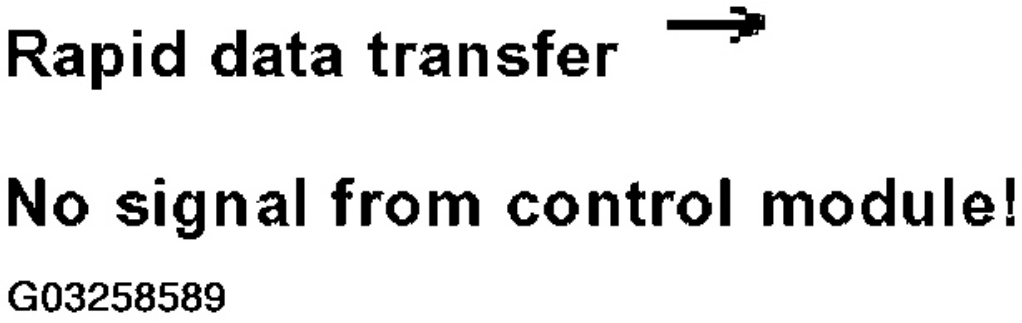

Fig. 114: Reconnecting Connector On Camshaft Position Sensor
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Hydraulic lifters, checking

Special tools and equipment

- Feeler gauge
- Wood or plastic wedge

NOTE:

- **Replace faulty lifter complete (cannot be adjusted or repaired).**
- **Irregular valve noises when starting engine are normal.**

Test sequence

- Start engine and run until radiator fan has switched on once.
- Increase engine speed to about 2500 RPM for approx. 2 minutes.

If the hydraulic lifters are still noisy, locate faulty lifters as follows:

- Remove cylinder head cover.
- Rotate crankshaft clockwise, until cam of tappet to be checked is pointing upward.
- Determine play between cam and hydraulic lifter.

If the play is in excess of 0.2 mm, replace hydraulic lifter. If the play is less than 0.1 mm or no play, proceed with check as follows:

- Push hydraulic lifter down lightly with a wooden or plastic wedge. If when hydraulic lifter is pushed down a 0.2 mm thick feeler gauge can be pushed between camshaft and hydraulic lifter, hydraulic lifter is to be replaced.

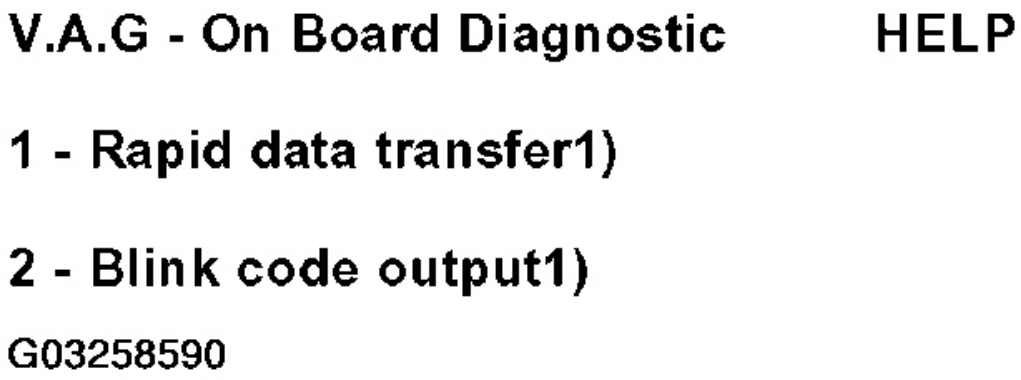

Fig. 115: Pushing Hydraulic Lifter Down Lightly With Wooden Or Plastic Wedge
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: After installing new lifters the engine must not be started for approx. 30 minutes. Hydraulic compensation elements must settle (otherwise valves will strike pistons).

Camshaft, removing and installing

(with cylinder head installed)

Special tools and equipment

- 3036 Counter hold tool
- 3366 Retainer
- VAG 1331 Torque wrench (5 to 50 N.m)
- VAG 1332 Torque wrench (40 to 200 N.m)
- AMV174 004 01 Sealant
- D454 300A2 Sealant

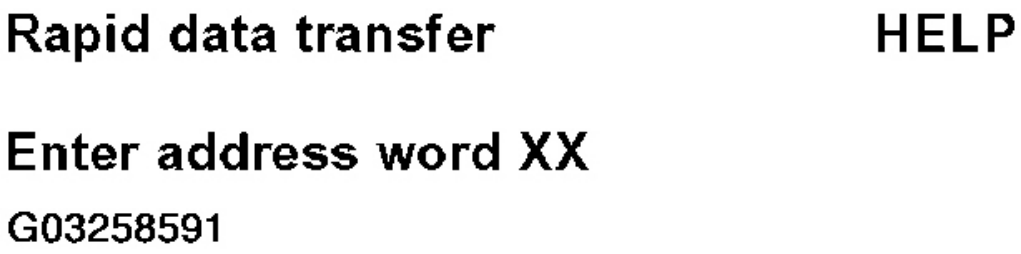

Fig. 116: Identifying Special Tools And Equipment
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Removing

- Remove engine cover.
- Remove toothed belt guard (upper part).
- Set camshaft sprocket to TDC No. 1 cylinder by turning crankshaft. Mark on camshaft sprocket must align with mark on cylinder head cover.

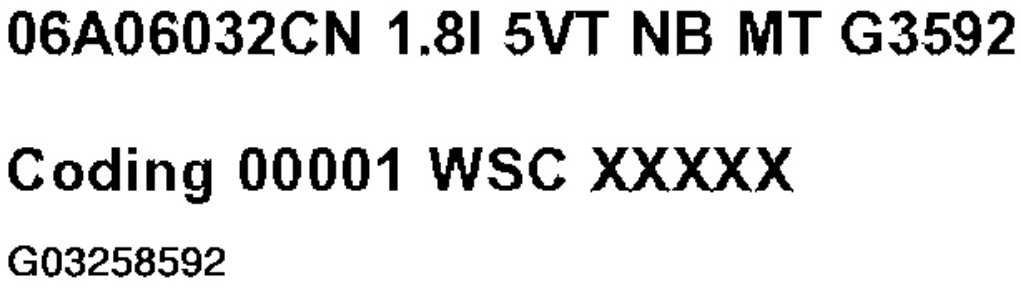

Fig. 117: Aligning Mark On Camshaft Sprocket With Mark On Cylinder Head Cover
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove cylinder head cover.
- Take toothed belt off camshaft toothed belt sprocket. See **REMOVING** .
- Turn crankshaft back slightly.
- Remove camshaft sprocket. When loosening camshaft sprocket bolt counter-hold with 3036.

- Remove woodruff key from camshaft.
- Remove Camshaft Position (CMP) sensor housing.
- Remove washer and hood for Camshaft Position (CMP) sensor.
- Clean drive chain and camshaft chain sprocket in area of arrows on bearing caps and mark installation position with a colored mark.

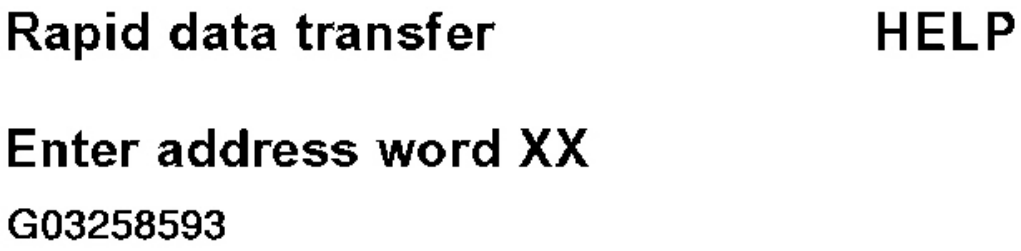

Fig. 118: Cleaning Drive Chain And Camshaft Chain Sprocket In Area Of Arrows On Bearing Caps
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE:

- **Do not mark chain with a punched mark, notch or similar.**
- **The distance between both arrows or the colored marks equals 16 rollers on the drive chain.**

- Secure chain tensioner with retainer for chain tensioner 3366.

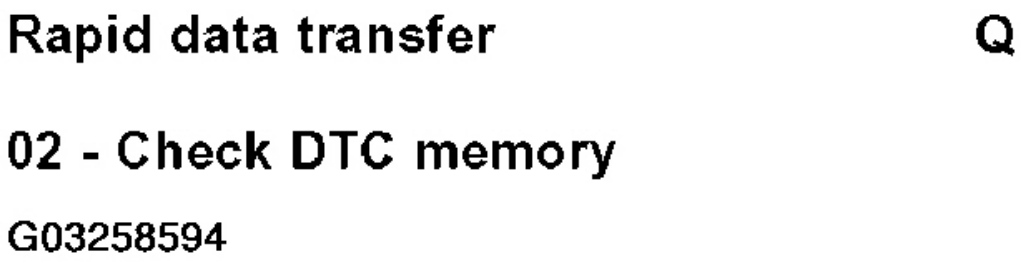

Fig. 119: Securing Chain Tensioner With Retainer For Chain Tensioner 3366
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: **Hydraulic chain tensioner can be damaged if chain tensioner retainer is overtightened.**

- Remove intake and exhaust camshafts 3rd and 5th bearing caps.

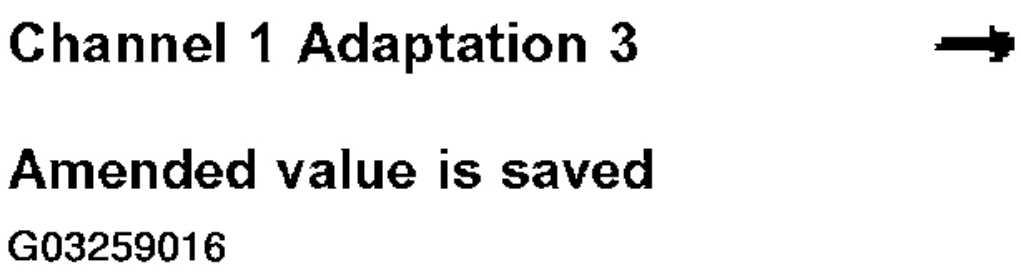

Fig. 120: Identifying Intake And Exhaust Camshaft Bearing Cap
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove double bearing cap.
- Remove both bearing caps at chain sprockets on intake and exhaust camshafts.
- Remove chain tensioner securing bolts.
- Remove intake and exhaust camshaft 2nd and 4th bearing caps using alternate and cross-over sequence.
- Remove chain tensioner for intake and exhaust camshafts and retainer for chain tensioner 3366.

Installing

NOTE:
- **When installing the camshafts the cams for No. 1 Cyl. must point upward.**
- **When installing the bearing caps, ensure that the cap markings can be read from the inlet side of the cylinder head.**

- Install drive chain onto both camshafts relevant to colored markings.

NOTE:
- **When using a new timing chain, the distance between notches -A- and -B- at the camshaft equals 16 rollers on the drive chain.**
- **The figure shows where on the sprockets the 1st and 16th rollers must be placed.**
- **Notch -A- is slightly offset toward inside to chain roller 1.**

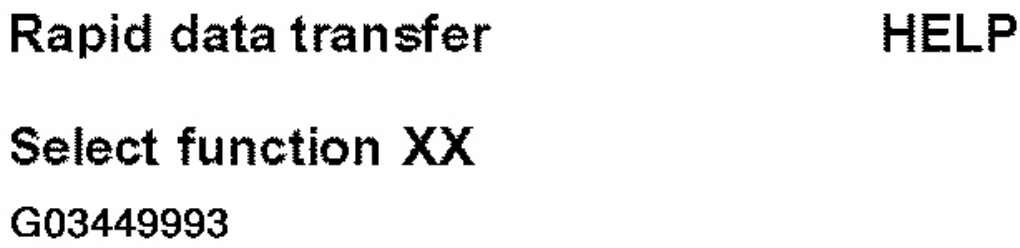

Fig. 121: Identifying Distance Between Notches -A- And -B- At Camshaft
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Replace rubber/metal seal for camshaft adjuster or chain tensioner and lightly coat hatched area with sealant D 454 300 A2.

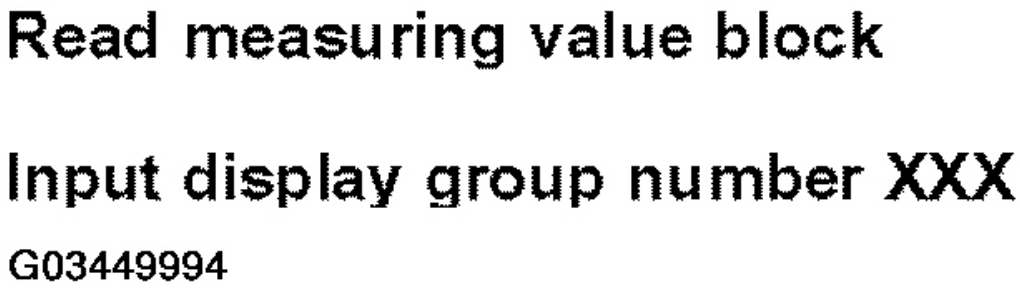

Fig. 122: Identifying Lightly Coated Hatched Area With Sealant D 454 300 A2
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Place chain onto camshaft gears as follows:
- Slide camshaft adjuster or chain tensioner between drive chain.
- Oil running surfaces of both camshafts.
- Place camshafts with drive chain and camshaft adjuster or chain tensioner in cylinder head.
- Tighten camshaft adjuster or chain tensioner to 10 N.m (take note of dowel sleeves).
- Tighten intake and exhaust camshaft 2nd and 4th bearing caps using alternate and cross-over sequence to 10 N.m (take note of dowel sleeves).

Fig. 123: Identifying Intake And Exhaust Camshaft Bearing Caps
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Install both bearing caps at chain sprockets for intake and exhaust camshafts. Check camshafts are positioned correctly and tighten bearing cap to 10 N.m (remember dowel sleeves).

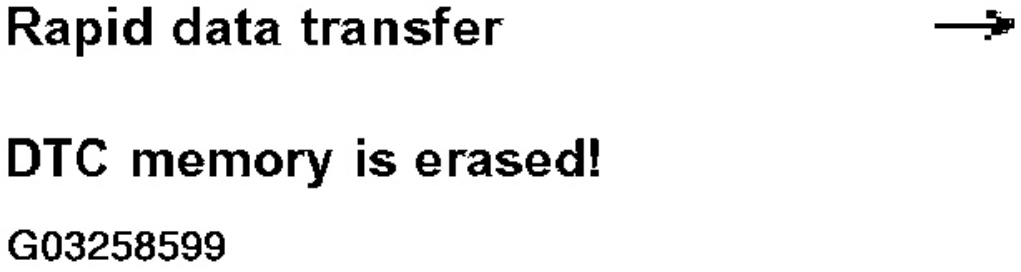

Fig. 124: Installing Both Bearing Caps At Chain Sprockets For Intake And Exhaust Camshafts
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove retainer for chain tensioner 3366.
- Coat hatched area of double bearing cap lightly with sealant D 454 300 A2, install and tighten to 10 N.m (remember dowel sleeves).

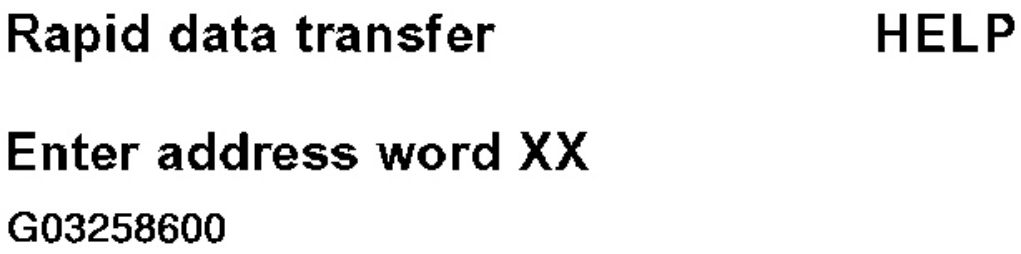

Fig. 125: Identifying Coated Hatched Area Of Double Bearing Cap With Sealant D 454 300 A2
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Install remaining bearing caps and tighten to 10 N.m (remember dowel sleeves).
- Observe installation position.
- Install camshaft sprocket. Bevelled edge of camshaft faces outward -arrows- and TDC Cyl. 1 is visible at front

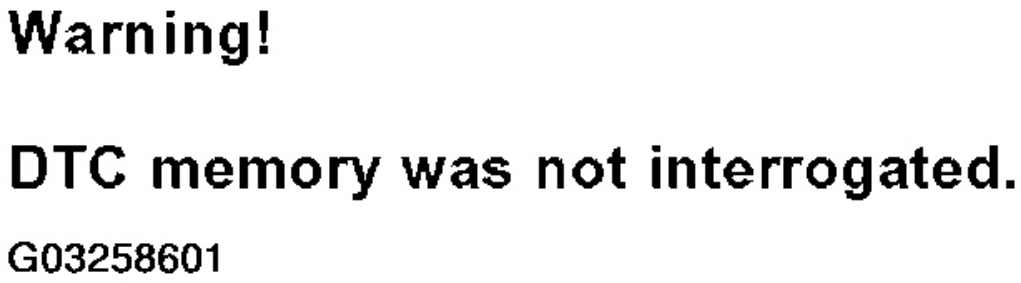

Fig. 126: Installing Camshaft Sprocket
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Tighten securing bolt to 65 N.m (use counter-hold tool 3036).
- Recheck position of camshafts relative to one another -arrows-.

Fig. 127: Rechecking Position Of Camshafts Relative To One Another
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Installing toothed belt and adjusting timing. See **TOOTHED BELT, REMOVING, INSTALLING AND TENSIONING** .

The rest of the assembly is basically a reverse of the disassembling sequence.

NOTE: After installing new lifters the engine must not be started for approx. 30 minutes. Hydraulic compensation elements must settle (otherwise valves will strike pistons).

Camshaft adjustment, checking

Only vehicles with engine codes: AWP, AWV

The adjustment of the camshaft occurs dependent upon load and engine RPM. The electrical valve for camshaft adjustment directs oil pressure to the camshaft adjuster (mechanical adjustment device), which then moves the camshaft.

Special tools and equipment

- VAG 1551 Scan Tool or VAG 1552 vehicle system tester with VAG 1551/3 cable
- Hand multimeter VAG 1526 or multimeter VAG 1715
- Adapter set VAG 1594
- VAG 1788/10 Engine speed adjuster

Checking activation

- Check activation of solenoid valve for camshaft adjustment via Output Diagnostic Test Mode.

  For engine code APH, see **OUTPUT DIAGNOSTIC TEST MODE (DTM)** . For engine codes AWP

and AWV, see **OUTPUT DIAGNOSTIC TEST MODE (DTM)** .

If activation is OK:

Checking solenoid valve

- Measure resistance between solenoid valve terminals.

  Specification: 10 to 18 ohms (room temperature)

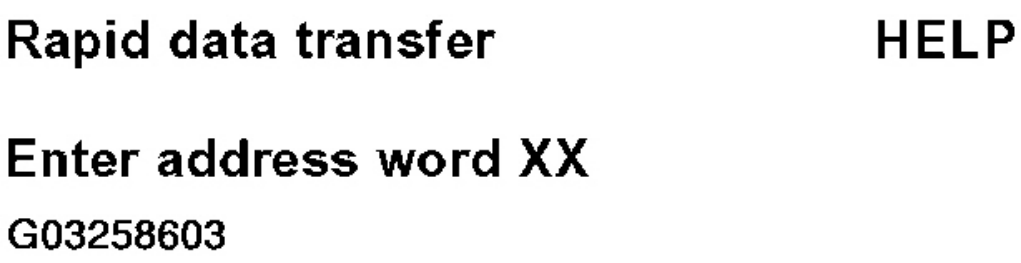

Fig. 128: Measuring Resistance Between Solenoid Valve Terminals
Courtesy of VOLKSWAGEN OF AMERICA, INC.

If valve is not faulty:

- Check function of camshaft adjuster

Checking function of camshaft adjuster

Test conditions

- Coolant temperature must be at least 85 °C, see display group 04, display zone 3.

Test sequence

- Connect VAG 1551 Scan Tool (or VAG 1552). Start engine and select Engine Control Module with "Address word" 01. Connecting scan tool and selecting Engine Control Module: See **CONNECT DIAGNOSTIC TESTER** .

Indicated on display:

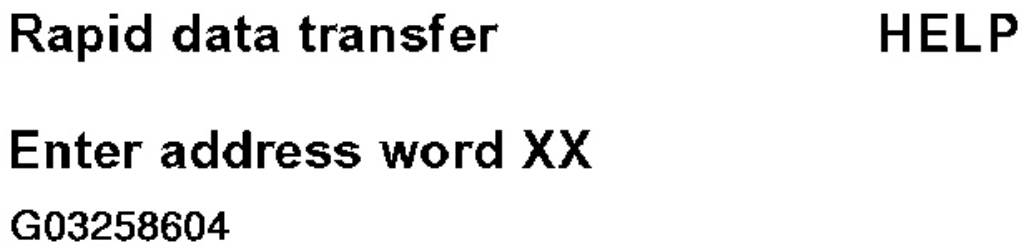

Fig. 129: V.A.G 1551 Scan Tool Display - Checking Function Of Camshaft Adjuster (1 Of 4)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press buttons -0- and -4- for function "Introduction of basic setting" and confirm entry with -Q- button.

Indicated on display:

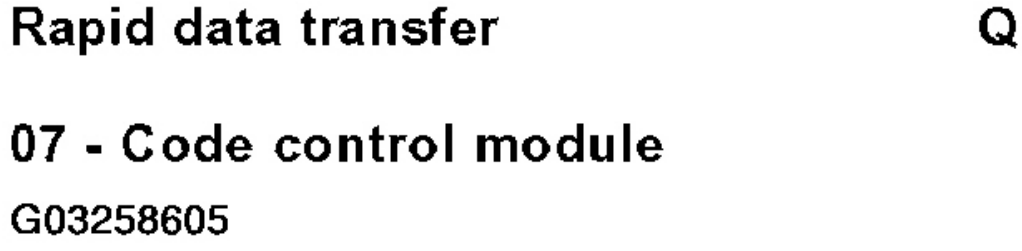

Fig. 130: V.A.G 1551 Scan Tool Display - Checking Function Of Camshaft Adjuster (2 Of 4)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press buttons -0-, -9- and -4- for "Display group number 94" and confirm entry with -Q- button.

Indicated on display: (1 to 4 = Display zones)

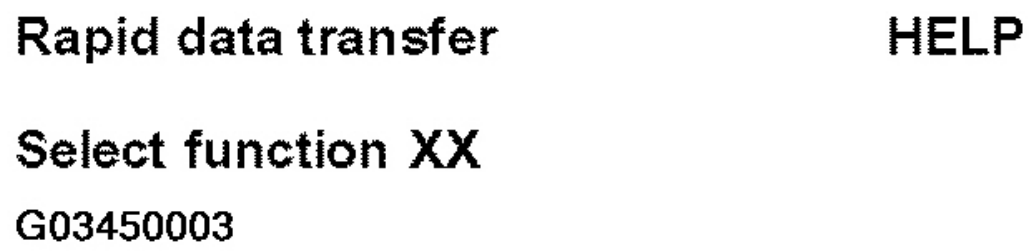

Fig. 131: V.A.G 1551 Scan Tool Display - Checking Function Of Camshaft Adjuster (3 Of 4)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Set engine speed to 1800 to 2200 RPM using speed regulator VAG 1788/10:
- Maintain engine speed at 1800 to 2200 RPM until display in display zone 3 jumps from

  "Test OFF" to "Test ON".

- Continue to maintain speed at 1800 to 2200 RPM until specification

  "Syst. OK" appears in display zone 3.

If the display does not indicate as described:

- Remove engine speed adjuster VAG 1788/10 from accelerator pedal.
- Press. See button.

Indicated on display

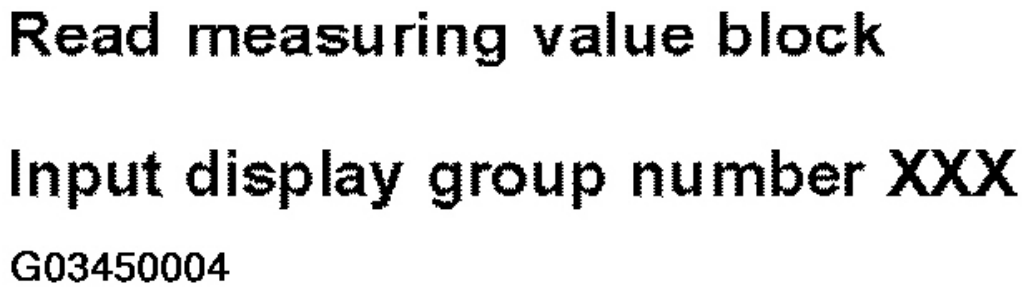

Fig. 132: V.A.G 1551 Scan Tool Display - Checking Function Of Camshaft Adjuster (4 Of 4)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press buttons -0- and -6- for function "End output" and confirm entry with -Q- button.
- Switch ignition off.

If "Syst. Nok" appears in display zone 3:

- Read DTC memory.

  See **GENERAL INFORMATION FOR ON BOARD DIAGNOSTIC (OBD)** .

If the DTC 17927 appears, it may be because:

The camshaft adjuster solenoid valve correctly switches oil pressure to the mechanical camshaft adjuster but it cannot reach its end position (e.g. tight/partially seized).

- Replace camshaft adjuster.
- Check DTC memory:

  See **GENERAL INFORMATION FOR ON BOARD DIAGNOSTIC (OBD)** .

- Read readiness code:

  See **READINESS CODE** .

If the DTC memory has been erased or the Engine Control Module separated from permanent (battery) positive, the readiness code must be generated again.

See **GENERAL INFORMATION FOR ON BOARD DIAGNOSTIC (OBD)** .

- Repeat functional check.

If the specification is not attained:

- Check wiring for open/short circuit between Engine Control Module to camshaft adjuster solenoid valve using wiring diagram:

  See appropriate SYSTEM WIRING DIAGRAM article.

If no wiring problem is detected:

- Replace Engine Control Module:

  See **REPLACING ENGINE CONTROL MODULE (ECM)** .

Valve guides, checking

Special tools and equipment

- VW 387 Universal dial indicator bracket
- Dial indicator

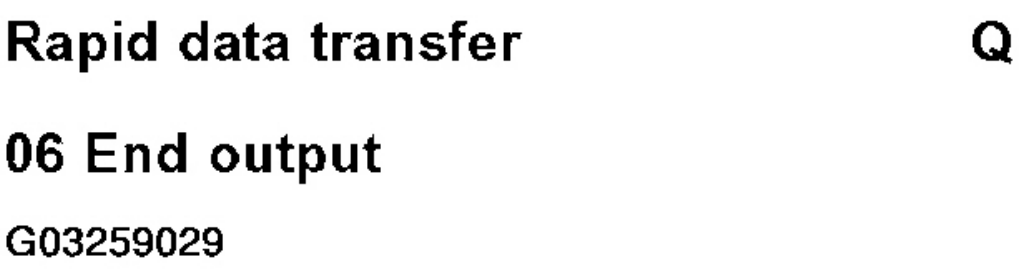

Fig. 133: Identifying Special Tools And Equipment
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Test sequence

- Insert new valve into guide until end of valve stem is flush with end of guide. Due to slight difference in stem dimensions, ensure that only an intake valve is used in intake guide and an exhaust valve in exhaust guide.

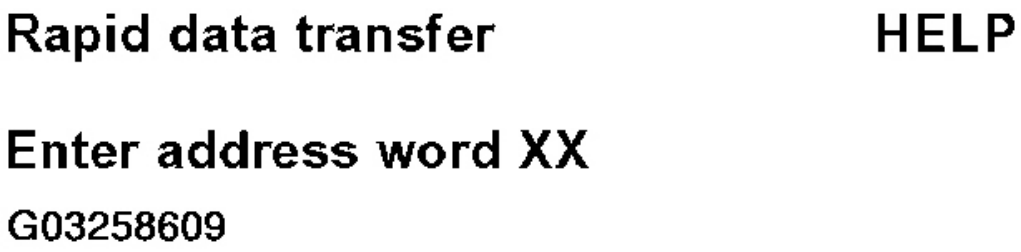

Fig. 134: Determining Valve Rock
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Determine valve rock.

  Wear limit: 0.8 mm

If rock tolerance is exceeded:

- Replace cylinder head.

Valve guides, replacing

Special tools and equipment

- Press tool VW 411
- Drift 3360
- Support 3361
- Hand reamer 3363 and cutting fluid

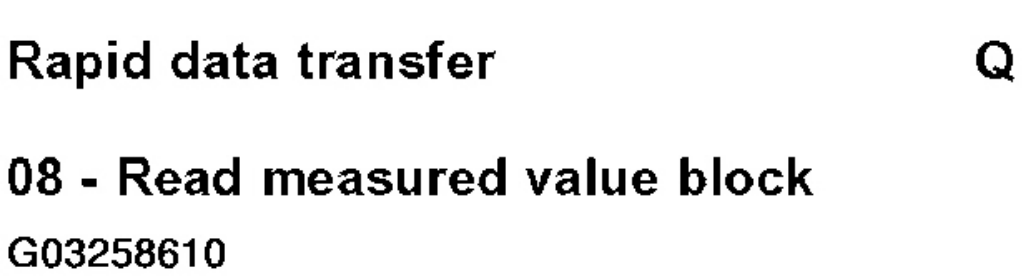

Fig. 135: Identifying Press Tool VW 411
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Removing

- Check whether valve seat insert rings and if necessary cylinder head sealing surface can be reworked. If not, then valve guide should not be replaced.

First set the support as follows:

- Install mount pins for cylinder head bolt holes -A- into threaded hole positions 2 and 3.

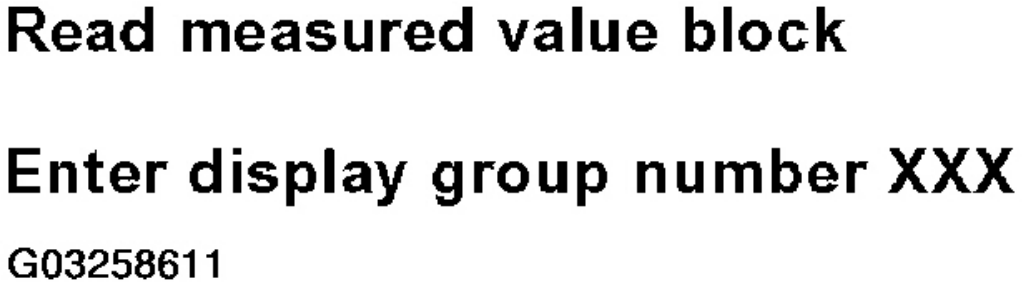

Fig. 136: Installing Mount Pins For Cylinder Head Bolt Holes -A- Into Threaded Hole Positions 2 And 3
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Install pin -B- into relevant hole for valve angle.
  - Outer intake valves: 21.5°

- Center intake valve: 15°
- Exhaust valve: 20°

- Press worn valve guides out with drift 3360 from camshaft side.

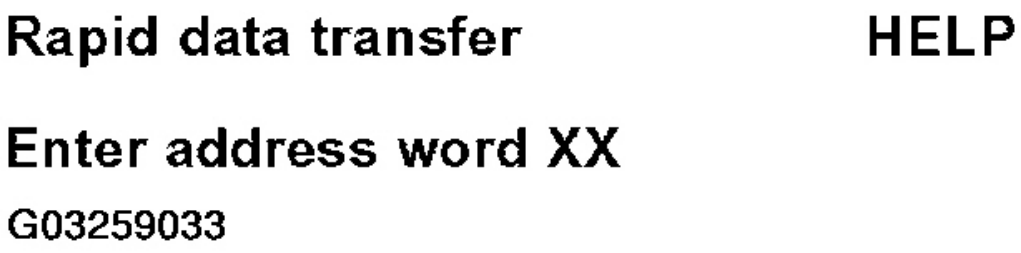

Fig. 137: Pressing Worn Valve Guides Out With Drift 3360 From Camshaft Side
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Installing

NOTE: When the shoulder on guide makes contact, the pressure must not exceed 10 kN (approx. 1.0 t) otherwise shoulder may break off.

- Coat new valve guides with oil and press with drift 3360 into cold cylinder head from camshaft side until shoulder makes contact.
- Ream guides out with hand reamer 3363 using plenty of cutting fluid.
- Rework valve seats. See **VALVE SEATS, REFACING** .

Valve stem seals, replacing

(with cylinder head installed)

Special tools and equipment

- VAG1331 Torque wrench (5-50 N.m)
- VAG1332 Torque wrench (40-200 N.m)
- 3122B Spark plug removal tool
- 3364 Puller
- VW 653/3 Pressure hose
- 3362 Valve spring compressor and press piece 3362/1

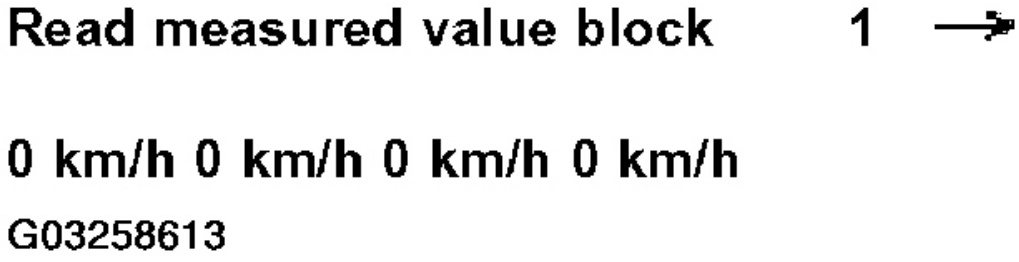

Fig. 138: Identifying Special Tools And Equipment
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- 3365 Fitting tool

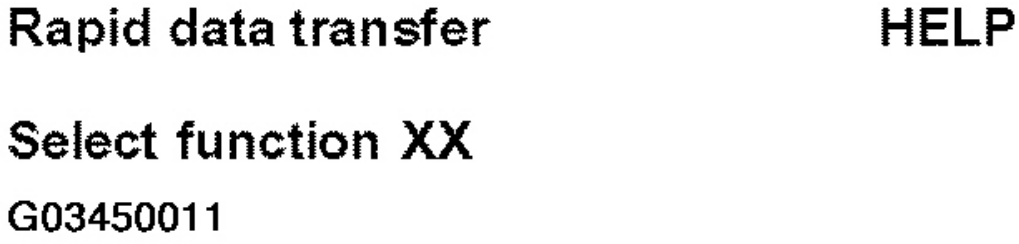

Fig. 139: Identifying 3365 Fitting Tool
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Removing

- Remove camshafts. See **CAMSHAFT, REMOVING AND INSTALLING** .
- Remove hydraulic lifters and place them with contact surface downward. When doing this ensure that lifters are not interchanged.
- Remove spark plugs with spark plug removal tool3122B.
- Set piston of appropriate cylinder to BDC (bottom dead center).
- Screw pressure hose VW 653/3 into spark plug thread.
- Mount fitting tool 3362 on cylinder head with fitting tool securing bolts.

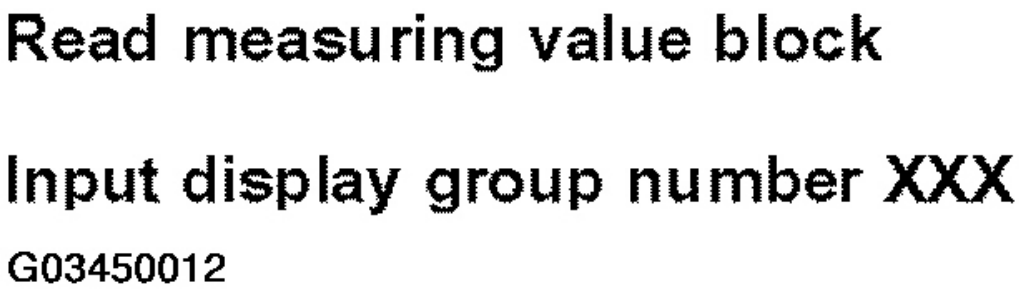

Fig. 140: Mounting Fitting Tool 3362 On Cylinder Head With Fitting Tool Securing Bolts
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Position fitting tool for compressing valve springs to one of following positions:

  Outer intake valves: lower position

  Center intake valve: upper position

  Exhaust valve: lower position

- Connect pressure hose to compressed air system supplying at least 6 bar and remove valve springs.
- Pull off valve stem seals with 3364.

Fig. 141: Pulling Off Valve Stem Seals With 3364
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Installing

- Place plastic sleeve -A- supplied on appropriate valve stem. This will prevent new valve stem seal being damaged.

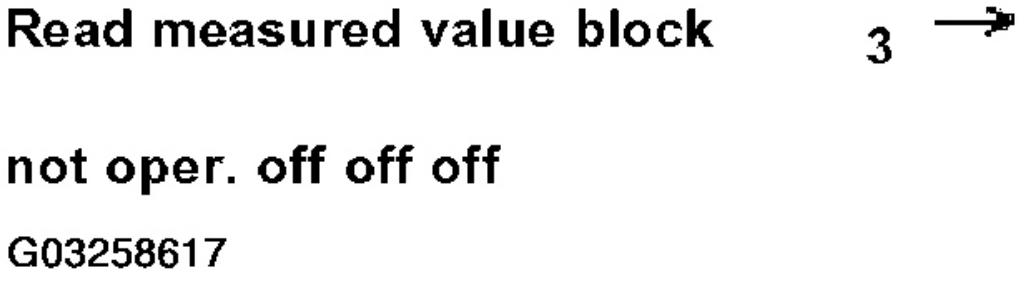

Fig. 142: Placing Plastic Sleeve -A- Supplied On Appropriate Valve Stem
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Place new valve stem seal in fitting tool 3365.
- Oil sealing lip of valve stem seal -B- insert in installation tool 3365 and press carefully onto valve guide.

The rest of the assembly is basically a reverse of the disassembling sequence.

ENGINE - LUBRICATION

LUBRICATION SYSTEM COMPONENTS, REMOVING AND INSTALLING

NOTE:

- **If large quantities of metal particles or other deposits (caused, for example, by partial seizure of the crankshaft or connecting rod bearings) are found in the engine oil when performing repairs, clean the oil passages thoroughly and replace the oil cooler in order to prevent further damage from occurring later.**
- **The oil level must not be above the max. mark, or there is danger of damage to the catalyst! Marking. See Markings On Oil Dipstick .**
  - **Thoroughly clean oil passages**
  - **Replace oil spray jets, oil cooler, and oil filter**

Checking oil pressure and oil pressure switch. See **OIL PRESSURE AND OIL PRESSURE SWITCH, CHECKING** .

Oil system capacity:

- Without oil filter: 4.0 liters
- With oil filter: 4.5 liters (4.8 qt.)

Oil Capacities up to MY 2000

Checking oil pressure. See **OIL PRESSURE AND OIL PRESSURE SWITCH, CHECKING** .

Engine oil specifications:

The following terms must appear on the oil container singly or in combination with other designations:

- VW 502 00 or VW500 00 or VW501 01
- ACEA A2 or ACEA A3
- API-SJ or API-SL

- Engine oils are graded according to their viscosity. The proper grade to be used in your engine depends on existing climatic or seasonal conditions.
- The engine oil which was first put into your engine has a viscosity grade of SAE 5W-40. You can use this oil over all temperature ranges for normal driving. If engine oil viscosity grade SAE 5W-40 is not available, you can also use SAE 5W-30.

Part I

Part II, disassembly oil filter bracket. See **PART II** .

NOTE: The following list refers to items in Fig. 143 .

1. **15 N.m**
2. **Sealing flange**
   - Must be located on dowel sleeves
   - Clean sealing surface before installing
   - Insert with silicone sealant D 176 404 A2. See **FRONT SEALING FLANGE, REMOVING AND INSTALLING** .
   - Replacing crankshaft oil seal (pulley end). See **CRANKSHAFT OIL SEAL (BELT PULLEY END), REPLACING** .
   - Removing and installing. See **FRONT SEALING FLANGE, REMOVING AND INSTALLING** .
3. **Chain tensioner with tensioning rail, 15 N.m**
   - Check for wear
   - When installing, pretension spring and install
4. **Chain sprocket**
   - For oil pump drive
   - Check for wear
5. **Cylinder block**
   - Removing and installing crankshaft. See **CRANKSHAFT, REMOVING AND INSTALLING** .

- Disassembling and assembling pistons and connecting rods. See **PISTONS AND CONNECTING RODS, DISASSEMBLING AND ASSEMBLING** .

6. **Dipstick**
   - Oil level must not be above max. mark!
   - Markings. See **Markings On Oil Dipstick** .
7. **Guide**
   - For dipstick
   - Pull off to extract oil
8. **Guide tube**
9. **Oil spray jet**
   - For piston cooling
10. **Pressure relieve valve, 27 N.m**
    - Opening pressure: 1.3 to 1.6 bar
11. **15 N.m**
12. **Suction pipe**
    - Clean strainer if soiled
13. **O-ring**
    - Replace
14. **Baffle plate**
15. **15 N.m**
    - Loosen and tighten with T-bar and socket, 10 mm 3185
    - Remove with hexagon key extension, 5 mm 3249
16. **Oil pan**
    - Clean sealing surface before installing
    - Install with silicone sealant D 176 404 A2. See **OIL PAN, REMOVING AND INSTALLING** .
    - Removing and installing. See **OIL PAN, REMOVING AND INSTALLING** .
17. **Oil drain plug, 30 N.m**
    - Replace if leaking. See Parts Catalog for correct application. In some cases, seal and drain plug are combined; do not interchange with separate seal and drain plug.
    - If sealing ring is leaking nip open and replace.
18. **Seal**
    - Replace
19. **Oil return pipe**
    - From turbocharger
20. **10 N.m**
21. **Oil pump**
    - With positive pressure relief valve 12 bar
    - Before installing, check that both dowel sleeves for centering oil pump/cylinder head are installed

- Replace if running surfaces and gears are scored

22. **Chain sprocket**
    - For oil pump
    - Check for wear
23. **25 N.m**
24. **Roller chain**
    - Mark direction of rotation before removing
    - Check for wear
25. **Dowel sleeves**
    - Check for tight fit

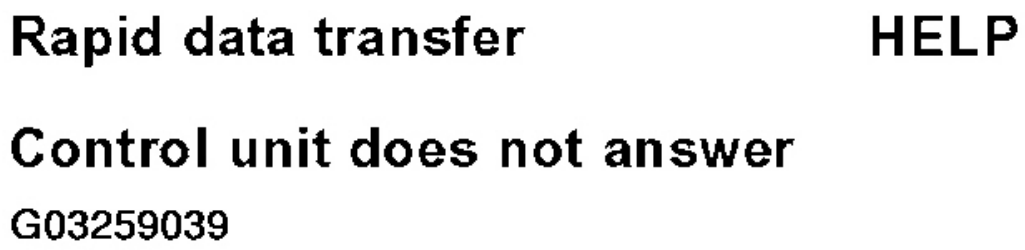

Fig. 143: Exploded View Of Lubrication System Components
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Markings On Oil Dipstick

1. max. mark
2. min. mark
    a. Area above hatched field up to max. mark: Do not top off with engine oil!
    b. Oil level within hatched field: can be topped off with engine oil
    c. Area from min. mark up to hatched field: fill with max. 0.5L. of engine oil!

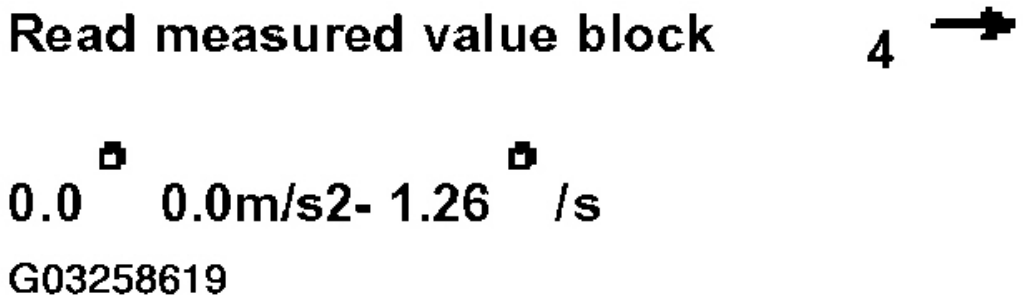

Fig. 144: Identifying Markings On Oil Dipstick
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Part II

NOTE: The following list refers to items in Fig. 145 .

1. **Sealing plug, 40 N.m**
2. **Seal**
   - If sealing ring is leaking nip open and replace.
3. **Spring**
   - For pressure relief valve, approx. 4 bar
4. **Piston**
   - For pressure relief valve, approx. 4 bar
5. **Gasket**
   - Replace
6. **Non-return valve, 8 N.m**
7. **O-ring**
   - Replace
   - Fit onto shoulder of connecting pipe 8 -
8. **Connecting pipe**
   - For cylinder block breather
9. **Retaining clip**
   - Check for tight fit
10. **Sealing plug, 15 N.m**
11. **Seal**
    - If sealing ring is leaking nip open and replace

12. **20 N.m**
13. **Oil supply pipe**
    - To turbocharger
14. **Banjo bolt, 30 N.m**
15. **Gasket**
    - Replace
16. **1.4 bar oil pressure switch -F1-, 25 N.m**
    - Black
    - Checking. See **OIL PRESSURE AND OIL PRESSURE SWITCH, CHECKING** .
17. **Seal**
    - If sealing ring is leaking nip open and replace
18. **15 N.m + 1/4 turn (90°) further**
    - Replace
19. **Gasket**
    - Replace
    - Install into groove on oil cooler
20. **Oil filter**
    - Loosen with strap wrench
    - Tighten by hand
    - Observe installation instructions on oil filter
21. **25 N.m**
22. **Oil cooler**
    - Ensure clearance to adjacent components
    - See note. See **LUBRICATION SYSTEM COMPONENTS, REMOVING AND INSTALLING** .
    - Coat contact area to flange, outside seal, with AMV 188 100 02
23. **Oil filter bracket**
    - With pressure relief valve approx. 4 bar

Fig. 145: Identifying Filter Bracket Assembly Components
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Oil pan, removing and installing

Special tools and equipment

- 3185 Extension socket wrench

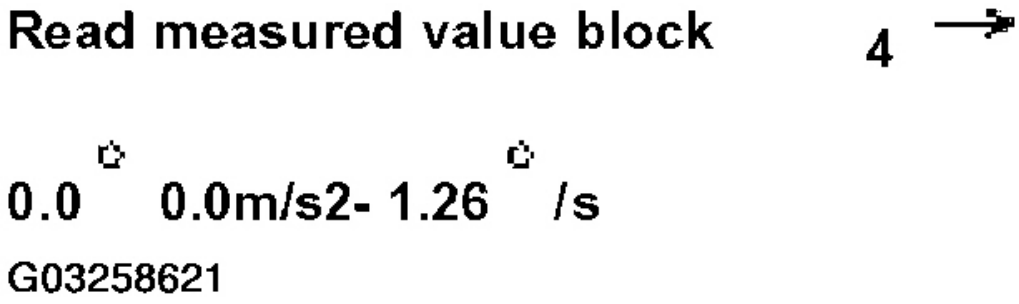

Fig. 146: Identifying 3185 Extension Socket Wrench
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- 3249 Socket

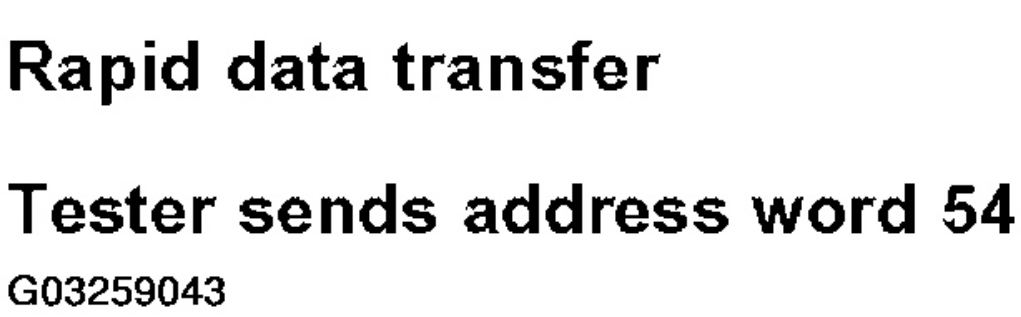

Fig. 147: Identifying 3249 Socket
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- VAG 1331 Torque wrench (5 to 50 N.m)
- Silicone sealant D 176 404 A2
- Hand drill with plastic brush
- Protective glasses
- Flat scraper

Removing

- Removing center and right insulation tray:

  See **PLENUM CHAMBER INNER COVER, REMOVING AND INSTALLING** .

- Drain engine oil.

NOTE: Observe disposal regulations!

- Detach turbocharger oil return pipe from oil pan.
- Loosen oil pan bolts using extension socket wrench 3185. Unscrew with socket 3249.
- Remove oil pan; it may be necessary to release oil pan by tapping lightly with a rubber head hammer.
- Remove sealant residue on cylinder block with a flat scraper.
- Remove sealant residue on oil pan with a rotating brush, e.g. a hand drill with a plastic brush (wear protective glasses).

Fig. 148: Removing Sealant Residue On Oil Pan With Rotating Brush
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Clean sealing surface; it must be free of oil and grease.

Installing

NOTE:

- **Note the use by date of the sealant.**
- **Oil pan must be installed within 5 minutes of applying silicone sealing compound.**

- Cut off tube nozzle at forward marking (nozzle approx. 3 mm diameter).

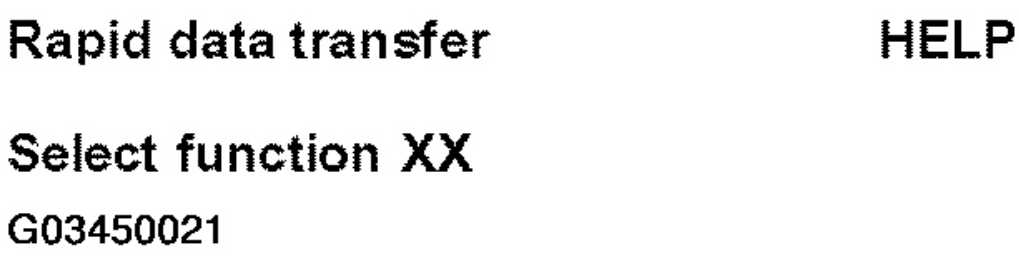

Fig. 149: Cutting Off Tube Nozzle At Forward Marking
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Apply silicone sealing compound, as shown, to clean oil pan sealing surface.

  Sealing compound bead must be:

  - 2-3 mm thick
  - and run on inside of bolt holes -arrows-

NOTE: **The sealing compound bead must not be thicker, otherwise excess sealing compound will enter the oil pan and may block the oil suction pipe strainer.**

- Apply silicone sealing bead as shown to clean sealing surface of oil pan (illustration shows position of sealant bead on cylinder block).

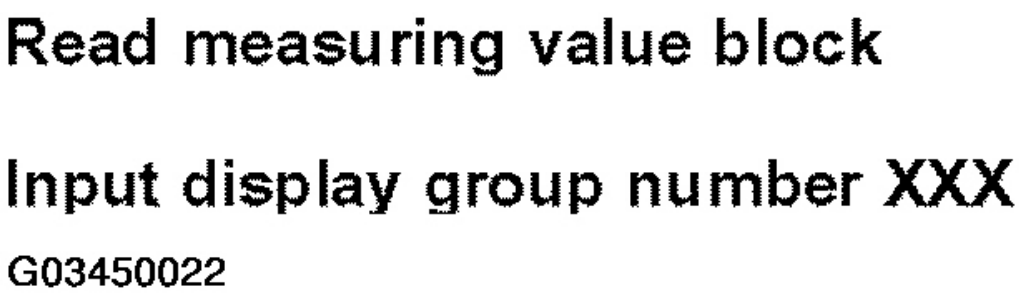

Fig. 150: Applying Silicone Sealing Bead To Clean Sealing Surface Of Oil Pan
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Install oil pan immediately and tighten bolts as follows:

1. Tighten all bolts oil pan/cylinder block very lightly and diagonally.
2. Lightly tighten three bolts oil pan/transmission.
3. Lightly tighten all bolts oil pan/cylinder block diagonally.
4. Tighten three bolts oil pan/transmission to 45 N.m.
5. Tighten all bolts oil pan/cylinder block diagonally to 15 N.m.
6. Tighten oil pan/oil return pipe to 10 N.m.

NOTE:

- **When installing the oil pan on an engine which is out of vehicle, ensure that the oil pan is flush with cylinder block on flywheel end.**
- **The sealant must be allowed to dry for approx. 30 minutes after installing the oil pan before the engine can be filled with engine oil.**

The rest of the assembly is basically a reverse of the disassembly sequence.

Oil pressure and oil pressure switch, checking

Special tools and equipment

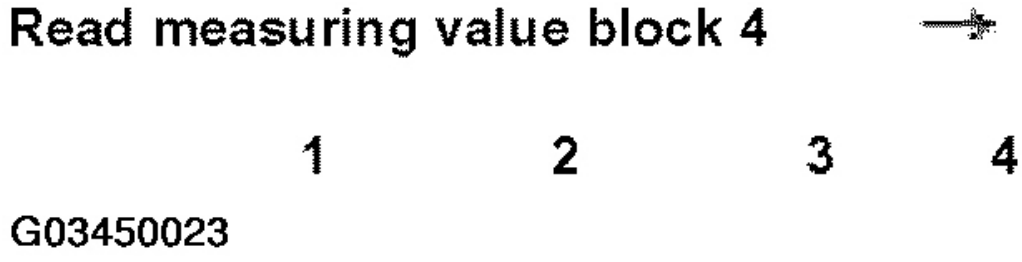

Fig. 151: Identifying Special Tools And Equipment
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- VAG 1342 Oil pressure tester
- VAG 1527 BLED test light
- VAG 1594 A Adapter set

Function of the dynamic oil pressure warning indicator

- When not under pressure, the oil pressure switch is open and will close when the operating pressure is attained.
- The oil pressure warning will be activated approx. 10 seconds after switching the ignition on.
- Switch-in delay of oil pressure warning: approx. 3 seconds.
- Switch-off delay of oil pressure warning: approx. 5 seconds.

NOTE: Functional check and servicing the optical and acoustic oil pressure warning:

See appropriate WIRING DIAGRAM article.

Checking warning lamp

After switching on the ignition without engine started, the oil pressure warning lamp in instrument cluster must light for approx. 3 seconds and then go out. The test will be terminated if the engine is running.

Criteria for warning

Switching on the optical oil pressure warning (the oil pressure warning lamp flashes) and the buzzer sounding three times for the acoustical warning will occur under one of the following conditions:

- "Ignition on," engine stationary, oil pressure switch closed

- Engine speed above 1500 RPM, oil pressure switch open

NOTE:

- **If the oil pressure switch is closed, the warning lamp will remain switched on if the engine speed is above 5000 RPM. The warning lamp will be switched off again if the engine speed is below 5000 RPM.**
- **If the oil pressure switch is open for 0.3-3.0 seconds when the engine speed is above 1500 RPM, it will be stored in the combi-processor in the instrument cluster. If this condition occurs three times when the engine is running, the oil pressure warning will be activated and will not be cancelled even below 1500 RPM. The oil pressure warning will be cancelled when the oil pressure switch is closed for longer than 5 seconds at an engine speed above 1500 RPM, or when the ignition is switched off.**

Test conditions

- Engine oil level OK. See **PART II**
- Oil Pressure Warning Lamp -K3- must light up for approx. 3 seconds when ignition is switched on
- Engine oil temperature at least 80° C (radiator fan must have run once)

Test sequence

- Remove Oil Pressure Switch -F1- and screw into tester.

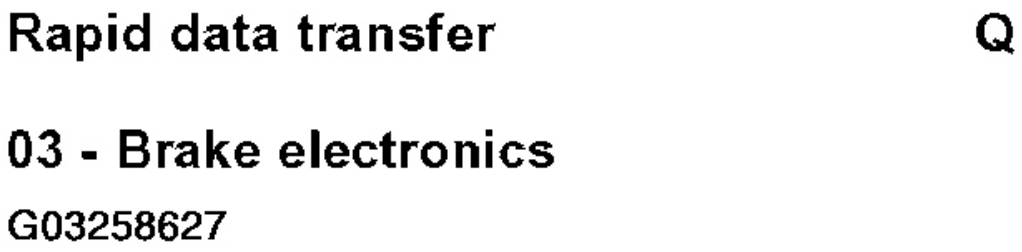

Fig. 152: Removing Oil Pressure Switch -F1- And Screwing Into Tester
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Screw tester into oil filter bracket in place of oil pressure switch.
- Connect brown wire of tester to Ground (-).
- Connect LED test light VAG 1527 B using aux. cables from VAG 1594 A to battery positive (+) and oil

pressure switch.

LED must not light up.

- If LED lights up, replace 1.4 bar Oil Pressure Switch -F1-.

When the LED does not light up:

- Start engine and run at idling speed:

  At 1.2-1.6 bar LED must light up, otherwise replace oil pressure switch.

- Check oil pressure at different RPMs:
  - Idle: at least 2.0 bar
  - 2000 RPM: 2.7 to 4.5 bar
  - Above 2000 RPM: maximum 7.0 bar

If the specifications are not obtained:

- Repair mechanical damage (e.g. bearing damage).
- Replace oil filter bracket with pressure relief valve (see **OIL PAN, REMOVING AND INSTALLING** , item 23) or replace oil pump (see **PART II** , item 21).

At higher engine speeds the oil pressure must not exceed 7.0 bar.

If the specification is exceeded:

- Check oil galleys.
- If necessary, replace oil filter bracket with pressure relief valve. See **OIL PAN, REMOVING AND INSTALLING** , item 23.